The Contributions of Dairy Foods to Cardiometabolic Health

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DISCLOSURES

Arne Astrup is the Scientific Board chairman of Reeducation Nutritionnelle et Psycho-Comportementale (RNPC) Scientific Committee (France) and is a member of the scientific boards of Azento Health (Switzerland) and Lipidio Pharma (United States). He is a board member of the Center for Healthy Childhood (Denmark), Concepteq (Denmark), and Eolo Pharma (United States). He serves as an advisor on National Dairy Council's Nourish Forward Collaborative.

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Katie Brown is an employee of National Dairy Council. As a check-off organization, National Dairy Council can provide science-based, factual information but cannot influence policy.

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INTRODUCTION

Nutrient-dense dairy foods (e.g., milk, yogurt, cheese, and kefir), which are the focus of this article, are foundational components of many healthy eating patterns.[1] Evidence supporting the health benefits of dairy foods extends over several decades, with clinical and observational evidence linking consumption of milk, cheese, and yogurt with favorable effects on body weight, as well as reduced risk of type 2 diabetes (T2D), cardiovascular disease (CVD), osteoporosis, sarcopenia, and colorectal cancer.[2,3] Notably, the benefits of dairy foods on cardiometabolic (CM) health, which refers to both cardiovascular and metabolic health outcomes, have been well documented through the landmark Dietary Approaches to Stop Hypertension (DASH) trial and the Prospective Urban Rural Epidemiology (PURE) study. Subsequent studies also support that dairy foods at a range of fat levels, both alone and as part of dietary patterns, can have neutral to beneficial effects on blood pressure, blood lipids, and CM outcomes.[4-8] These outcomes have advanced our understanding of the nutritional and health attributes of dairy foods and increasingly are attributed to the unique package of nutrients and bioactive compounds within the dairy food matrix.

Consistent with this growing body of evidence, nutrition guidance has continued to shift focus from isolated nutrients to a more food- and eating pattern–based approach.[9-12]

Key takeaways

- Nutrient-dense dairy foods are foundational components of many healthy eating patterns. Ninety percent of the US population does not meet daily dairy recommendations, contributing to shortfalls in key nutrient intakes. Closing this consumption gap offers an opportunity to achieve nutrient adequacy, improve overall diet quality, and support CM health.
- Saturated fats from dairy foods do not appear to confer CM risk in the same way as saturated fats from other dietary sources, challenging traditional diet-heart paradigm assumptions.
- Dairy foods provide high-quality protein that may help promote muscle preservation, particularly among older adults or patients using obesity medications. Maintaining muscle during weight loss may act as a protective mechanism for CM health.
- Decades of research show that dairy foods have neutral to beneficial effects on CM health, supporting their role in a balanced diet.
- The dairy food matrix helps explain why dairy foods—regardless of fat content—can support CM health. It reflects how the micronutrients, macronutrients, and bioactive compounds in dairy foods interact within a food's physical structure to shape health outcomes.
- 3 servings of nutrient-dense dairy foods at a variety of fat levels can be part of a cardioprotective eating pattern that also meets patients' personal preferences and health goals.

Dietary guidance from a variety of leading health and medical organizations, including the American Heart Association, the American Diabetes Association, and the 2025-2030 US Dietary Guidelines for Americans, recognizes regular consumption of nutrient-dense dairy foods in balanced, calorie-appropriate dietary patterns.[13-15] Mounting attention among scientific and medical communities also has highlighted that whole- and reduced-fat dairy foods affect health differently than isolated saturated fats or other saturated fat-containing foods, contributing to a growing consensus on the role of the dairy food matrix to inform a holistic, food-based lens for public health guidance.[16-19] Nevertheless, dairy consumption remains low. Approximately 90% of people in the United States do not meet dairy intake recommendations and fall short of key nutrients, including calcium, vitamin D, and potassium, that may benefit CM health.[20] Yet, messaging related to CM health more frequently highlights the importance of consuming whole grains, fruits, and vegetables without equal emphasis on consuming nutrient-dense dairy foods.

Evidence-based strategies to help close the dairy food gap, aligned with the state of the science linking dairy foods to CM health, offer a practical opportunity to improve overall diet quality and CM health. This article explores how dairy foods at a variety of fat levels can contribute to CM health outcomes and offers practical strategies for primary care clinicians (PCCs) to guide patients on how to incorporate 3 daily servings of dairy foods while acknowledging their preferences and health goals.

DAIRY FOODS AND CM HEALTH: THE BODY OF OBSERVATIONAL AND CLINICAL EVIDENCE

The latest state of the evidence on CM health includes more than a dozen reviews published since 2020. They assessed decades of clinical and observational research on dairy food consumption and its relationship with overweight and obesity, T2D risk, and CVD outcomes (**TABLES 1** and **2**).

Dairy foods and overweight and obesity

Obesity is a major risk factor for and cause of T2D and CVD.[21] Dairy foods consumed as part of healthy, calorie-balanced dietary patterns can contribute to healthy weight management, which can reduce long-term health risks.[22,23] Studies link dairy food consumption with neutral to beneficial impacts on weight management.[22,24-31] In fact, when dairy food consumption is increased without energy restriction in clinical research, results suggest no significant effects on weight, fat mass, lean mass, or waist circumference, while increased dairy food consumption as part of an energy-restricted diet may result in lower fat mass and body weight.[29] Because of the high-quality protein dairy foods provide, several health organizations, including the Obesity Medicine Association, the American Society for Nutrition, the American College of Lifestyle Medicine, and the Academy of Nutrition and Dietetics, recommend dairy foods for individuals taking glucagon-like peptide 1 (GLP-1) receptor agonist medications to help them meet protein consumption targets and preserve lean mass during rapid weight loss.[32,33] In addition to being high in protein, dairy foods also provide multiple important micronutrients (e.g., calcium, vitamin D, magnesium, phosphorus, and potassium) that have been linked with bone mass retention during weight loss.[34-42] The retention of both muscle and bone mass during weight loss is associated with better CM health outcomes.[43,44]

Clinical Relevance: Preservation of lean mass during weight loss is clinically meaningful, especially in older adults and patients using obesity medications such as GLP-1 receptor agonists. Dairy foods provide complete protein that may help promote satiety,[45] muscle preservation,[46] and healthy weight management[22] among adult patients across the weight spectrum.

Dairy foods and T2D

Obesity is a leading driver of T2D development, and obesity-related T2D increases the risks of CVD since the combination creates a high-risk state of metabolic dysfunction, chronic inflammation, hypertension (HTN), and dyslipidemia.[47-49] Thus, strategies that support glycemic control are central to CM health. Several major studies have summarized the research on dairy foods and glycemic control, prediabetes, and/or T2D risk.[2,22,50-56] The findings from these reviews and recent randomized controlled trials (RCTs) indicate that dairy foods support normal glucose regulation across a range of populations, including those who are healthy as well as those who have prediabetes, metabolic syndrome, or T2D.[57-62] Total dairy consumption of ~3 servings/day was linked to a 25% lower risk of developing prediabetes compared with 0 servings/day.[50] Higher consumption of total dairy, low-fat dairy, and yogurt was associated with lower risk for T2D, whereas whole-fat dairy foods and cheese generally were linked with neutral associations and not an increased risk.[22,51,54] Based on the evidence, regular daily consumption of dairy foods at a variety of fat levels is associated with neutral to beneficial effects on glucose homeostasis.[57-62]

Higher consumption of yogurt may have unique glucoregulatory benefits.[51,63-67] In 2024, the US Food and Drug Administration (FDA) announced a qualified health claim that identifies a potential link between regular yogurt consumption and a reduced risk of T2D, stating, "Eating yogurt regularly, at least 2 cups (3 servings per week), may reduce the risk of T2D according to limited scientific evidence."[63]

TABLE 1. Dairy foods and cardiometabolic health biomarkers: clinical evidence reviews published since 2020.

Study type	Population	Key findings
Systematic review of 15 meta-analyses of RCTs[55]	Healthy adults	Neutral effects of total dairy, full-fat, and low-fat dairy on blood lipids or BP Modest benefits of probiotic yogurt for BP blood lipids, and HbA1c
Systematic review and meta-analysis of 19 RCTs[48]	Healthy adults	Both low-fat and full-fat dairy improved SBP but, concomitantly, may impair glycemic control Yogurt improved waist circumference, TG, and HDL compared with milk
Systematic review and meta-analysis of 10 RCTs[56]	Healthy adults	Dairy fat from cheese improved blood lipid profiles relative to dairy fat from butter Reductions in fasting TC, LDL, and HDL with cheese consumption but not with butter
Systematic review and meta-analysis of 18 RCTs[57]	Adults with or without metabolic abnormalities	Higher consumption of dairy foods had neutral effects on blood lipids
Systematic review and meta-analysis of 39 RCTs[58]	Adults with high cholesterol	Reductions in TC and LDL with probiotic fermented milk consumption Neutral effects on HDL and TG levels with probiotic fermented milk consumption
Systematic review and meta-analysis of 7 RCTs[6]	Adults with high cholesterol	Reductions in TC and LDL with probiotic yogurt consumption No differences in HDL and TG with probiotic yogurt consumption
Systematic review and meta-analysis of 6 RCTs[59]	Mixed populations	Reductions in fasting blood glucose and insulin levels with kefir consumption
Systematic review and meta-analysis of 6 RCTs[60]	Mixed populations	Reductions in fasting insulin and HOMA-IR with kefir consumption Neutral effects on blood lipids with kefir consumption
Systematic review of 14 RCTs and 37 noncontrolled interventions[61]	Healthy adults	Beneficial to neutral effects on blood lipids with yogurt and kefir consumption

Abbreviations: BP, blood pressure; HbA1c, glycated hemoglobin; HDL, high-density lipoprotein; HOMA-IR, homeostatic model assessment for insulin; LDL, low-density lipoprotein; RCT, randomized controlled trial; SBP, systolic blood pressure; TC, total cholesterol; TG, triglycerides.

This qualified health statement acknowledges the health benefits of yogurt as a food. Similarly, other dairy foods can provide important nutrients such as calcium, vitamin D, and protein; however, some products may also contain added sugars. Both the FDA and the Centers for Disease Control and Prevention emphasize limiting added sugar intake as part of a healthy diet. Additionally, the 2025-2030 US Dietary Guidelines for Americans recommends limiting added sugar within healthy eating patterns to consuming no more than 10 g of added sugar per meal and, for snacks, following limits set by the FDA (i.e., no more than 2.5 g of added sugar per ⅔ cup equivalent of dairy snacks like yogurt).[13] Taken

TABLE 2. Dairy foods and cardiovascular disease risk and clinical endpoints: observational evidence reviews published since 2020.



Study type	Total dairy	Dairy by fat level	Milk	Yogurt	Cheese
Systematic review of 17 meta-analyses[55]	≤200 g/day: no association with CVD or CHD incidence or mortality	Whole and low-fat: no association with CVD or mortality	≤200 mL/day: no association with CVD	≥200 g/day: ▼CVD	50 g/day: ▼CHD
Systematic review and meta-analysis of 42 studies[18]		Low-fat: ▼6% HTN	▼6% HTN per 200 g/day increase		
Systematic review of 33 studies and meta-analysis of 20 studies[62]	No association with CHD or stroke	Whole and low-fat: no association with CHD or stroke	▼12% ischemic stroke ▲8% CHD with whole milk		▼4% CHD per 20 g/day
Scoping review of 25 systematic reviews[42]	Neutral/ favorable for CVD				
Scoping review of 24 systematic reviews and/ or meta-analyses[43]	Neutral/ beneficial for CM outcomes	Neutral to beneficial CVD effects		Neutral to beneficial CVD effects	Neutral to beneficial CVD effects
Umbrella review of 26 meta-analyses[63]	▼11% HTN ▼4% CVD ▼13% stroke	Whole-fat: ▼8% stroke Low-fat: ▼11% stroke ▼13% HTN	▼3% CVD ▼10% stroke	▼8% CVD	
Systematic review and meta-analysis of 55 studies[64]	▼9% HTN ▼4% CHD ▼10% stroke	Whole and low-fat ▼stroke			

Abbreviations: CHD, coronary heart disease; HTN, hypertension.

together, a variety of yogurt and other nutrient-rich dairy foods, including options across a range of fat levels and those that are lightly sweetened, may fit into a calorie-appropriate, balanced eating pattern that emphasizes nutrient-dense foods to reduce the risk of T2D and promote CM health.

Clinical Relevance: Nutrient-dense dairy foods at a range of fat levels can help support blood glucose regulation in healthy patients as well as those with prediabetes or T2D. Yogurt may have distinct benefits for glucose homeostasis.

Dairy foods and CVD

CVD is the leading global cause of mortality and is responsible for nearly 1 in 3 deaths.[68] Dietary modifications generally are recommended as a primary preventive treatment against developing CVD and as a secondary preventive treatment against CVD recurrence and mortality.[69,70] Multiple studies have shown neutral to beneficial effects of dairy food consumption on anthropometrics, blood lipids, and blood pressure (**TABLE 1**).[6,7,61,71-77] Clinical studies found that consuming ~3 servings/day of dairy foods regardless of

fat content had a neutral impact on anthropometrics and CVD biomarkers.[7,58,61,62,78] Additionally, short-term (3 to 12 weeks) yogurt consumption, including whole-fat options, had moderate yet consistent benefits on body composition and blood lipids.[61,62]

Several evidence reviews also have concluded that higher total consumption of dairy foods is linked to beneficial to neutral effects on CVD risk and mortality (**TABLE 2**).[22,76,79-81] Lower rates of HTN and stroke were linked to total- and low-fat dairy and milk consumption.[2,79-81] Fermented dairy foods like yogurt and cheese were also linked to lower risk for CHD, CVD, and CVD mortality.[52,76,79,81-84] Conversely, 1 study found that whole milk consumption had a negative effect on CVD risk.

Clinical Relevance: Adequate consumption of dairy foods at a variety of fat levels can help support healthy blood lipid profiles and may reduce patient risk for CVD and CVD mortality. Fermented dairy foods may have distinct benefits for CM health.

Re-examining the diet-heart paradigm: saturated fat compared to whole foods

Reducing dietary saturated fat is a hallmark of the diet-heart paradigm that originated in the 1950s, which proposed that saturated fat consumption elevates low-density lipoprotein cholesterol (LDL-C) and increases CVD risk. Research indicates that whole- and reduced-fat dairy foods are not linked with the same CVD risks as other foods containing saturated fats.[10,62] In fact, the intake of naturally occurring saturated fats in nutrient-dense dairy foods is linked with neutral to beneficial effects on blood lipid profiles, including total LDL-C, particle size distribution, and high-density lipoprotein cholesterol (HDL-C).[61,62,72,85]

LDL-C remains the mainstream biomarker to assess CVD risk; however, emerging research indicates predicting risk may be more complex, and a suite of biomarkers and risk factors may assess risk better than LDL-C alone. Dietary-induced change in LDL cholesterol does not always lead to a corresponding change in CVD endpoints, as many other mediators of risk may be contributing to the atherosclerotic process. Other emerging risk factors include LDL particle sizes, blood triglycerides, apolipoproteins A1 and B, HDL function, ratios of total cholesterol to HDL-C or total triglycerides to HDL-C, coronary and carotid artery atherosclerotic plaques, markers of inflammation, and measures of insulin resistance.[86,87]

Clinical Relevance: Dairy foods across a range of fat levels may be a part of a balanced, calorie-appropriate, and healthy eating pattern.

DAIRY FOOD MATRIX EFFECTS AND CM HEALTH

Different types of dairy foods—including milk, yogurt, cheese, and kefir—each have a unique food matrix. The dairy food matrix refers to the array of nutrients and bioactive compounds found within the unique physical structures of dairy foods.[19,88] The food matrix effect is an emerging concept in research that may provide support for dairy foods' benefits on CM health (**TABLE 3**). Emerging research indicates nutrients and bioactive compounds may work together to affect digestion and absorption, potentially creating a greater impact of dairy on CM health.[9,53,89,90] Therefore, a food matrix and food-based approach may provide a deeper understanding of why whole- and reduced-fat dairy foods affect CM outcomes differently than isolated saturated fats or other saturated fat–containing foods.[16-18]

The unique combination of nutrients and bioactive ingredients in the dairy food matrix includes high-quality protein, vitamins and minerals, bioactive peptides and lipids, prebiotics, and live and active cultures in some fermented dairy foods. Emerging research has linked dairy components with potential benefits on CM health.[18,91-100] For example, whey and casein are the main proteins in milk; they are high-quality proteins based on their amino acid profiles.[42] The combination of whey and casein offers both fast- and slow-digesting proteins, which may favorably affect food intake, blood pressure, and metabolism.[101,102] Milk fat is also complex, containing more than 400 fatty acid types as well as unique polar lipids that are part of the milk fat globule membrane.[103] These lipids have been linked to potential benefits on inflammation and gut health and may favorably influence lipid metabolism.[19,104,105] While more research is needed to understand better the role of the food matrix in CM health, the current evidence supports a greater emphasis on whole-food approaches, including dairy foods, in nutrition and clinical guidance.

IMPLICATIONS FOR EVIDENCE-BASED PRACTICE

For more than 4 decades, authoritative nutrition and medical dietary guidance to improve CM health has emphasized consuming multiple daily servings of dairy foods to achieve nutrient adequacy.[106-108] While public health recommendations historically have been directed toward low-fat and fat-free dairy options, decades of research link dairy foods at various fat levels with CM health. This distinguishes the health effects of saturated fat in dairy foods from other dietary sources of saturated fat.[4-8,16-19] However, the majority of people in the United States do not meet dairy intake recommendations and fall short of key nutrients that dairy foods can provide.[20] Given persistent gaps between recommended and actual dairy food consumption, routine clinical visits can be an opportunity for PCCs to help patients

TABLE 3. Dairy food components and potential mechanisms to promote cardiometabolic health.

Dairy component	Potential protective mechanisms
High-quality protein	Can support weight management and lean muscle mass retention during weight loss[32]
Bioactive peptides	Linked with potential benefits for oxidative stress and inflammation, blood pressure regulation, immune health, and glucose control[42]
Bioactive lipids[a]: milkfat globule membrane, polar lipids, fatty acids	Linked with potential benefits on inflammation, gut health, metabolism, and body weight regulation[104]
Calcium	Plays a critical role in heart muscle contraction and blood vessel constriction/dilation; adequate calcium levels are linked with better weight management, insulin sensitivity, and lipid metabolism[91-92]
Magnesium	Supports blood pressure regulation, vascular tone, lipid metabolism, and insulin sensitivity[93,94]
Potassium	Helps offset and balance sodium levels to help reduce blood pressure; enhances endothelial function and stabilizes cardiac electrophysiology[95-97]
Vitamin D[b]	Supports calcium absorption; helps reduce inflammation; regulates the renin-angiotensin-aldosterone system, which influences blood pressure and heart function[98]
Live and active cultures and fermentation metabolites[b]	Linked with potential benefits in supporting healthy gut microbiota, reducing inflammation, improving blood lipid profiles, reducing blood pressure, and enhancing insulin sensitivity[99,100]

[a]Present in dairy foods except for fat-free varieties.

[b]Found in some, but not all dairy foods.

meet recommendations for 3 daily servings as part of healthy dietary patterns (**TABLE 4** and **FIGURE**).

Collective evidence indicates that recommending fat flexibility, such as consuming a balanced mix of whole- and low-fat dairy foods, and engaging in discussions with lactose-intolerant patients about available dairy options that include lactose-free and lower-lactose dairy foods are part of an approach toward reaching dairy food recommendations within overall nutritionally adequate, healthy diets. PCCs play a critical role in translating food-based dietary guidance into practical, patient-centered recommendations.

SUMMARY

Dietary guidance for CM health typically has focused on improving consumption of whole grains, fruits, and vegetables without similar acknowledgment of dairy foods. However, the body of evidence consistently shows that dairy foods and the nutrients they provide can be beneficial for CM health, with emerging insights into the dairy food matrix helping to explain benefits associated with whole- and reduced-fat dairy foods. Despite this evidence and authoritative nutrition guidance recognizing the contributions of dairy foods to healthy diets, most people in the United States do not meet recommendations for nutrient-dense dairy foods like milk, yogurt, cheese, and kefir. There are multiple dairy foods with different amounts of fat and lactose that can help meet a range of patient preferences and health needs. PCCs can play a key role in providing food-based guidance to help their patients achieve nutrient adequacy, meet dairy recommendations, and improve CM health. Closing this gap through routine assessment of dairy consumption, individualized guidance for lactose intolerance, and referral to registered dietitians to support fat-flexible, calorie-appropriate dietary patterns represents an opportunity to improve diet quality and CM health. ●

TABLE 4. Practical applications: strategies for food-based guidance to support adequate dairy food consumption and CM health for patients.

- **Screen** patients for adequate consumption of all food groups; refer them to a registered dietitian for counseling as needed to achieve healthy, calorie-balanced eating patterns.
- **Order testing** beyond LDL to examine a comprehensive set of risk factors and biomarkers. When appropriate, follow up with direct assessments of carotid artery atherosclerotic plaque by ultrasound.[109]
- **Advise** patients to meet dairy food recommendations to help achieve intake of nutrients that support CM health and that most Americans under consume, including calcium, vitamin D, and potassium. Dairy foods contain essential nutrients that are hard to replace with nondairy foods that are similar in price and calories.[110]
- **Manage** lactose intolerance to maintain adequate dairy intake:
  - Many dairy food options are lactose free (e.g., lactose-free milk) or are naturally lower in lactose, such as yogurt, kefir, and certain cheeses.
  - Consume lactose-containing foods in small doses at mealtimes.
  - Consider taking lactase or probiotic supplements.[111]
- **Incorporate** fat flexibility:
  - Dairy foods across a range of fat levels may be a part of a balanced, calorie-appropriate, and healthy eating pattern.
  - Consider taste, personal preferences, and health and wellness needs when providing guidance about how to achieve dairy adequacy.
  - Well-balanced, low-carbohydrate diets, which often are higher in fat, may be beneficial for those with impaired glucose metabolism.[112]

FIGURE. Guiding patients to support cardiometabolic health with dairy foods.



Figure adapted from National Dairy Council

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