SCIENCE BRIEF: Whole and Reduced-Fat Dairy Foods and CVD Risk

New science supports reassessing the role of dairy foods in healthy eating patterns

Overview

The 2015-2020 Dietary Guidelines for Americans (DGA) recommend choosing low-fat and fat-free milk, cheese or yogurt as part of healthy eating patterns. Dairy foods (such as milk, cheese, yogurt) make significant nutrient contributions to U.S. diets, including nutrients underconsumed by most Americans—calcium, vitamin D and potassium—as well as magnesium, phosphorus, zinc, vitamin A, vitamin B12, riboflavin (B2), choline, high-quality protein and saturated fat. Recommendations to reduce saturated fat consumption are intended to lower rates of cardiovascular disease (CVD), including coronary heart disease (CHD or heart attack) and cerebrovascular disease (stroke). In recent years, however, emerging research has found that saturated fat consumption may not be directly linked to CVD risk, indicating saturated fat on its own may be a poor metric for identifying healthy foods or diets. In addition, observational and trial evidence has found that dairy food consumption—regardless of fat content—is not associated with higher risk for CVD. The growing evidence base supports reassessing the role of whole and reduced-fat dairy foods in healthy eating patterns to inform future nutrition guidance regarding CVD and other cardiometabolic diseases.

Healthy eating patterns are linked to lower risk for CVD

Eating 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.”[1] The 2015-2020 DGA relied heavily on evidence linking eating patterns and health outcomes and notes that “dietary components of an eating pattern can have interactive, synergistic, and potentially cumulative relationships, such that the eating pattern may be more predictive of overall health status and disease risk than individual foods or nutrients.”[2]

The DGA found that “strong evidence shows that healthy eating patterns and regular physical activity are associated with a reduced risk of CVD,” which was the strongest grade for any chronic disease or health condition reviewed.[2] Healthy eating patterns were defined, in general, as including low-fat or fat-free dairy foods (such as milk, cheese or yogurt), vegetables from all subgroups, fruits (mostly whole), grains (half of them whole), a variety of protein foods and oils. The DGA recommends specific eating patterns to exemplify the general recommendations, including the Healthy U.S.-Style Pattern, which is unchanged from 2010, and the Healthy Vegetarian and Healthy Mediterranean-Style Patterns.

Dairy foods are an important source of a unique package of nutrients to the diets of Americans. The 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 Eating Pattern.[2] At current average consumption (fewer than 2 servings per day), milk, cheese and yogurt contribute 54% of calcium, 56% of vitamin D, 14% of potassium, 18% of protein, 29% of vitamin A, 27% of vitamin B12, 25% of riboflavin (B2), 12% of magnesium and 17% of zinc to the U.S. diet, but only 11% of total calories.[3] Modeling studies find that when dairy foods are removed from healthy eating patterns, calcium, magnesium, iron, vitamin A and riboflavin (B2) drop below 100% of dietary goals, and vitamin D, potassium and choline drop even lower.[1] The nutrients in dairy foods are difficult to replace with other foods in a healthy eating pattern, including calcium-equivalent foods.[1,4]

Characteristics of DGA-recommended eating patterns are similar to recommendations in the 2013 American Heart Association (AHA)/American College of Cariology (ACC) lifestyle guidelines for adults who would benefit from lowering blood pressure or LDL-cholesterol (LDL-C), a biomarker associated with higher risk for CVD.[4] The AHA/ACC recommend an eating pattern that emphasizes consumption of vegetables, fruits and whole grains, includes low-fat dairy products, poultry, fish, legumes, non-tropical vegetable oils and nuts, and limits consumption of sweets, sugar-sweetened beverages and red meats.[5] This eating pattern is based on the Dietary Approaches to Stop Hypertension (DASH) trial, which found that following an eating plan that contained 2-3 servings of dairy foods and 8-10 servings of fruits and vegetables per day reduced saturated fat, total fat and cholesterol consumption, and lowered blood pressure in adults with elevated blood pressure.[6]

All of these guidelines include recommendations to reduce saturated fat consumption to 10% of calories or less. Emerging evidence, published in approximately the last 10 years, has begun to challenge recommendations to reduce saturated fat by choosing low-fat or fat-free dairy foods instead of whole and reduced-fat dairy foods. This brief will summarize emerging research that indicates whole or reduced-fat dairy foods, in addition to low-fat or fat-free dairy foods, can be included in healthy, calorie-balanced eating patterns.

Current guidance to lower CVD risk advises decreasing saturated fat consumption

Cardiovascular disease is the leading cause of death in the U.S.,[7] and recommendations to lower saturated fat consumption to lower risk for CVD have been part of the DGA for many years. These recommendations are based on evidence that links higher saturated fat consumption to higher blood levels of LDL-C. Recommendations to “avoid too much fat, saturated fat and cholesterol” were part of the 1980 DGA, and in 1985, recommendations were added to “use skim or low-fat milk or milk products.”[8,9] In 1990, consistent with AHA recommendations, the DGA specified upper limits for total fat of 30% of calories, and for saturated fat of 10% of calories.[10,11] The Institute of Medicine’s (IOM) Acceptable Macronutrient Distribution Range (AMDR) report was published in 2005,[12] and the 2005 and subsequent DGA recommended a range of 20-35% of calories from total fat for adults, maintained recommendations to consume no more than 10% of calories from saturated fat and recommended low-fat or fat-free dairy foods.[13,14]

The 2015-2020 DGA notes that “intake of saturated fats should be limited to less than 10% of calories per day by replacing them with unsaturated fats and while keeping total dietary fats within the age appropriate AMDR.”[2] The DGA removed the quantitative limit on cholesterol; it also, however, specified that eating patterns that meet DGA saturated fat guidance would be low in cholesterol.[2] The DGA states, in addition, that the limit on calories from saturated fats is not an Upper Limit (UL) set by the IOM. To meet saturated fat guidelines in the context of dairy consumption, the DGA recommends choosing low-fat or fat-free dairy foods, more milk and yogurt in place of cheese, and choosing lower fat cheese in place of regular cheese.[2]

The AHA, in its dietary recommendations to lower risk for CVD, took a more conservative approach regarding saturated fat recommendations than the DGA. In 2006, the AHA recommended limiting consumption of saturated fat to 7% of energy and choosing low-fat or fat-free dairy products to help meet these recommendations.[15] The 2013 AHA/ACC Guideline on Lifestyle Management to Reduce Cardiovascular Risk recommends, for adults who would benefit from lower LDL-C, “Aim for a dietary pattern that achieves 5-6% of calories from saturated fat” as part of a healthy eating pattern.[5] Like the 2015 DGA, the AHA did not include a quantitative cholesterol guideline, noting, “there is insufficient evidence to determine whether lowering dietary cholesterol reduces LDL–C.”[5]

Both the 2016 Recommended Dietary Pattern to Achieve Adherence to the AHA/ACC Guidelines and the 2017 AHA Presidential Advisory on dietary fats and CVD continue to recommend 7% of calories from saturated fat for the general healthy public and advise replacing saturated fat with unsaturated fat to lower the incidence of CVD.[16,17]

Emerging evidence finds saturated fat consumption may not be linked to CVD risk

Despite authoritative guidance to reduce saturated fat consumption to lower risk for CVD, emerging evidence published over the past 10 years examining saturated fat consumption and CVD endpoints indicates that saturated fat per se may not be directly associated with CVD risk. Several publications found that populations consuming higher amounts of saturated fat do not have higher risk for CVD than those who consume lower amounts.[18,19,20,21] One of these, for example, conducted for the World Health Organization and published in 2015, found "no clear association between higher intake of saturated fats and all-cause mortality, CHD, CHD mortality, ischemic stroke, or type 2 diabetes among apparently healthy adults."[20] In the same study, consumption of industrially-produced trans fats was associated with all-cause mortality, CHD and CHD mortality.[20] This emerging scientific evidence examining disease endpoints, rather than LDL-C, indicates that the biomarker broadly used to predict risk for CVD risk might not be the most appropriate in all cases.

Replacing saturated with unsaturated fat may modulate CVD risk

What does the science say about current recommendations to replace saturated fat with unsaturated fat? These studies acknowledge the macronutrient trade-offs that occur with recommendations to reduce dietary fat; however, studying the effect of one or two nutrients may not account for the total diet effects on CVD risk.[22]

Both trials and observational studies have evaluated how replacing dietary saturated fat with other macronutrients, such as unsaturated fat or carbohydrates, influences risk for CVD. A Cochrane review of intervention trials assessed the effect of reducing saturated fat consumption and replacing it with carbohydrate, polyunsaturated fat or monounsaturated fat on mortality and cardiovascular morbidity.[23] The review found no effect of lowering saturated fat, compared to a control diet, on risk for all-cause mortality or cardiovascular mortality. Compared to usual diet, however, lowering saturated fat consumption reduced the risk for cardiovascular events (heart attacks and stroke, combined). In subgroup analyses, the reduction in cardiovascular events was seen in studies that replaced saturated fat with polyunsaturated fat, but not with monounsaturated fat, carbohydrates or protein.[23] In addition, several large prospective studies and a meta-analysis have found that modeling replacement of saturated fat with polyunsaturated fat is linked to reduced risk for CVD, while replacing saturated fat with carbohydrates has little or no benefit.[18,19,20,23,24,25,26,27]

The relationship, however, may be more complex than that. A cross sectional, multi-modeling analysis of the association of nutrients with risk factors for CVD from 18 countries in North America, South America, Europe, Africa and Asia found that substituting saturated fatty acids with unsaturated fatty acids improved some risk factors, such as LDL-C, but worsened others, such as HDL-cholesterol (HDL-C) and triglycerides. Replacing saturated fatty acids with carbohydrate had an adverse effect on blood lipids.[28] This study concluded that current recommendations to reduce total and saturated fats are not supported and cautioned that focusing on a single lipid marker for CVD, such as LDL-C, may not capture the impact of various dietary nutrients on CVD.[28]

In the context of overall eating patterns, the importance of macronutrient replacements may be overstated because people eat foods as part of eating patterns that introduce additional variables, such as additional nutrients and bioactive compounds, that may impact disease risk.

Emerging evidence finds dairy food consumption is not linked to higher risk for CVD

During the same timeframe that the new evidence on saturated fat and CVD outcomes was emerging, another body of evidence found that consumption of dairy foods, including whole, reduced-fat, low-fat and fat-free, has neutral or inverse associations with risk for CVD. The 2010 Dietary Guidelines Advisory Committee (DGAC) reviewed evidence published through mid-2009 about the relationship between milk and milk product consumption and selected health outcomes.[29] Based on that review, the 2010 DGA stated: "Moderate evidence…indicates that intake of milk and milk products is associated with a reduced risk of cardiovascular disease and type 2 diabetes and with lower blood pressure in adults."[14]

Between 2009 and 2017, at least 10 systematic reviews and/or meta-analyses and 13 cohort studies have been published.[30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53] Overall, this growing body of evidence indicates that dairy food consumption, regardless of fat content, is not linked to higher risk for CVD, CHD or stroke, and in some cases, consumption is linked to lower risk.[48] The selected studies below contribute to evolving science that may provide a better understanding of the link between dairy food consumption and risk for CVD.

- A systematic review based on 13 meta-analyses published beginning in 2004, plus 11 additional prospective cohort studies (PCS) published between 2004 and 2016, concluded:[48]
    - Total dairy food consumption, as well as yogurt consumption, is not associated with higher risk for CVD (moderate-quality evidence).
    - Cheese consumption is not associated with higher risk for CVD (high-quality evidence).
    - Total dairy food consumption, as well as cheese consumption, is associated with lower risk for stroke (moderate-quality evidence).
    - Milk consumption is not associated with risk for stroke (moderate quality-evidence).
- A meta-analysis of 29 PCS in adults found total dairy and milk consumption, including high- and low-fat varieties, was not associated with higher risk for CHD or CVD. Total fermented dairy was associated with lower risk for CVD. Cheese consumption was associated with a 2% lower risk for CVD for every 10 grams consumed per day when all studies were included in the analysis.[49] Others have reported similar findings linked with cheese consumption — Alexander, et. al. reported an 11% lower risk for CVD per 35 grams per day,[50] while Chen, et. al. reported a 10% lower risk for CHD per 50 grams per day.[51]
- A meta-analysis of 21 PCS involving 19 cohorts concluded that consumption of 200 ml per day of milk was not associated with all-cause mortality, fatal or non-fatal CHD and fatal or non-fatal stroke.[52]
- A meta-analysis of 18 PCS concluded that 200 grams per day of total milk consumption was associated with 7% lower risk for stroke, and cheese consumption was associated with a lower risk for stroke. Risk reductions were maximal at approximately 125 grams per day for milk and 25 grams per day for cheese.[53] In a limited number of studies, 200 grams per day of high-fat milk was associated with higher risk for stroke.
- A meta-analysis of 15 studies concluded that cheese consumption was associated with lower risk for CVD, CHD and stroke. The largest risk reductions for CVD were observed with the consumption of approximately 40 grams per day of cheese.[51]

Because most of the evidence on these dairy health outcomes is observational, and the heterogeneity of dairy foods in observational studies can make it difficult to tease out the effects of specific high-fat or low-fat dairy foods, randomized controlled trials are needed to better understand the potential mechanisms underlying these observations.

A modified DASH diet containing whole milk dairy foods demonstrates DASH benefits

The standard DASH eating pattern is a reduced-fat plan containing, daily, eight to 10 servings of fruits and vegetables, two to three servings of dairy, whole grains, poultry, fish and nuts.[54] Characteristics of the DASH eating pattern are consistent with DGA recommendations.[13,14] A controlled trial examined the health effects of including higher-fat dairy foods in a modified DASH diet and found the higher-fat dairy consumed as part of a healthy eating pattern did not negatively affect lipid biomarkers related to risk for CVD—and improved some of them. Study participants consumed each of three diets for three weeks, separated by two-week washout periods: a control diet, the standard DASH diet and a modified high-fat DASH diet in which low-fat or fat-free dairy foods were replaced with regular (full-fat) versions, and carbohydrates were reduced to maintain calories.[55] Compared to the standard DASH diet, the modified DASH diet increased saturated fat from 8% to 14% of calories, increased total fat from 27% to 40% of calories and reduced carbohydrates from 55% to 43% of calories. Researchers measured the effects on blood pressure and blood lipid markers.

Compared to the standard DASH diet, the modified DASH diet lowered blood pressure to the same degree, reduced blood levels of triglycerides and did not increase total cholesterol, LDL-C or HDL-C.[55] This study demonstrates that whole milk and dairy foods can be incorporated into a healthy eating pattern that is calorie-balanced and improves standard biomarkers related to heart disease risk. More randomized controlled trials that incorporate whole and reduced-fat dairy foods into healthy eating patterns are needed to help understand the mechanisms underlying these effects, as well as the long-term impact of such diets.

What is the link between whole and reduced-fat dairy foods and body weight?

Whole and reduced-fat dairy foods contain more calories than low-fat and fat-free versions, and balancing calories is an important part of healthy eating. A healthy, calorie-balanced diet containing higher-fat dairy foods has been demonstrated to have positive health benefits.[55] The eating pattern used in the trial that compared a modified DASH diet containing whole milk dairy foods to the standard DASH diet, described in more detail above, accommodated the additional calories from whole milk dairy foods by reducing carbohydrate content, mainly sugars.[55]

In observational studies, the association between dairy food consumption and body weight is not always as expected based simply on fat and calorie content. For example, a systematic review concluded that the observational evidence does not support an association between dairy fat or high-fat dairy foods and obesity or cardiometabolic risk,[56] and a study of three PCS found no link between the consumption of most dairy foods and long-term weight gain.[57] In a Women's Health Study cohort of more than 18,000 women followed for 17 years, among women who were normal weight at baseline, higher consumption of high-fat dairy products, but not of low-fat dairy products, was associated with less weight gain.[58] Consumption of high-fat dairy was also associated with lower risk for overweight and obesity, but total dairy, low-fat dairy, specific dairy products except yogurt, and calcium or vitamin D were not.[58] In another study among 4,545 high-risk participants of the Prevention with Mediterranean Diet (PREDIMED) study, whole milk yogurt consumption was associated with an average yearly decrease in waist circumference of 0.23 centimeters in the highest (52.5 grams per day) compared to the lowest (1.7 grams per day) quintile of consumption.[59] In a study of 19,352 perimenopausal women in Sweden, consumption of one or more servings of cheese per day was associated with 30% less weight gain after a nine-year follow-up.[60] In the same study, among participants with a healthy weight at baseline, whole and sour (fermented) milk were associated with 27% lower weight gain over nine years of follow-up.[60]

These observational studies do not support the hypotheses that consuming whole and reduced-fat dairy foods leads to weight gain and that choosing low-fat dairy foods prevents it.[56] In some studies, reverse causation may have contributed to the findings,

for example, if the study participants who were overweight at baseline, and more likely to gain weight over time, favored low-fat dairy foods because they contain fewer calories and were perceived to help prevent weight gain.[56] More research is needed to understand the mechanisms underlying these observations, and how dairy foods as part of a calorie-balanced, nutrient-dense eating pattern may impact body weight.

The complete dairy food matrix may influence CVD risk

The food matrix has been defined as "the nutrient and non-nutrient components of foods and their molecular relationships, i.e. chemical bonds, to each other."[61] It refers to the physical form of a food, and how its components, including nutrients, interact with each other. It is a helpful concept when examining the effects of different food sources of saturated fat on biological or health outcomes. Emerging evidence indicates that the food matrix of dairy foods may modulate the effects of dairy fat on CVD biomarkers and associated risk.[62]

Beef, cheese and milk are among the top food sources of dietary saturated fat in the U.S.,[63] and most studies do not differentiate between food sources of saturated fat when evaluating links to CVD risk. In the Multi Ethnic Study of Atherosclerosis (MESA) adult cohort, researchers compared risk for CVD associated with consumption of saturated fat from meat or dairy.[64] Consumption of saturated fat from meat was associated with a higher risk for CVD, while consumption of saturated fat from dairy foods was associated with lower risk for CVD. Each 5-gram increase in dairy saturated fat per day was associated with 21% lower risk for CVD, and each 5% increase in energy from dairy saturated fat was associated with 38% lower risk.[64] Though more research is needed to determine what is driving this difference, the authors point out that "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." The authors also note that the observed differences between food-specific saturated fat and CVD may explain why "overall saturated fat consumption, summed from all sources, has not been significantly associated with incident CVD…".[64] Thus, specifying the food source of saturated fat may be helpful information in nutrition research and guidance.

Cheese consumption may have effects that differ from expectations based on saturated fat content. A randomized controlled trial in 139 subjects who had two or more risk factors for metabolic syndrome found that daily consumption of regular-fat cheese for 12 weeks did not alter LDL-C or risk factors for metabolic syndrome differently than the same amount of reduced-fat cheese or an isocaloric amount of carbohydrate-rich foods.[65] A meta-analysis of five clinical trials examining cheese consumption and blood lipids found that hard cheese lowers blood levels of total cholesterol, LDL-C and HDL-C in trials that compare cheese consumption to the equivalent amount of dairy fat (as butter).[66] The authors noted that "the results consistently showed that the effects of cheese on lipids and lipoproteins were different than expected from the fat content."[66] They also concluded that more research is needed to help determine the characteristics of cheese that may contribute to these findings, indicating the calcium content, specific types of fatty acids, and effects of the food matrix in cheese warrant further study.[64] Another meta-analysis of 15 PCS concluded that cheese consumption was associated with lower risk for CVD, CHD and stroke.[51] The largest risk reductions for CVD were observed with the consumption of approximately 40 grams (approximately 1.3 ounces) per day of cheese.

A prospective study conducted in a large Dutch adult population found that higher saturated fat consumption was associated with lower risk for ischemic heart disease (IHD).[67] This Dutch population had a fairly high consumption of saturated fat from dairy foods, with cheese, milk and milk products, and butter contributing 41% of saturated fat consumption. Researchers modeled replacing saturated fat with other macronutrients, and they also separated out the impact of dairy fatty acids from other sources of saturated fat. They concluded that lower IHD risk "did not depend on the substituting macronutrient," but rather depended on

the fatty acids found in dairy foods, specifying "the chain length and food source of saturated fatty acids" that were associated with lower risk. These included a slightly lower risk for IHD associated with the sum of short chain fatty acids (four to 10 carbons) and odd-chain fatty acids (15 and 17 carbons) commonly found in dairy fat, as well as the saturated fatty acids from specific dairy foods, including butter, cheese, milk and milk products. They found no associations between consumption of saturated fat from other food sources and IHD risk. They also found that replacing saturated fat with carbohydrates, polyunsaturated fat or animal protein was associated with a higher risk for IHD compared to saturated fatty acids.

The two studies that examined contributions of dairy saturated fat separately from other foods, mentioned above, both found a lower risk associated with consumption of saturated fat from dairy foods. Neither was able, however, to determine whether the result was due to the dairy fat alone, the characteristics of the dairy food with which the fat was consumed, or both.[64,67]

Dairy fat is a part of the dairy food matrix

"Saturated" describes the chemical structure of a fatty acid, but this single term does not reflect the tremendous variation in the types of saturated fat found in foods. The fat in milk is the most complex fat naturally occurring in a food.[68] In the U.S., whole milk contains no less than 3.25% milkfat, and approximately two-thirds of milkfat is saturated fat and one-third is unsaturated fat (including monounsaturated and polyunsaturated fatty acids). Dairy fat contains over 400 types of fatty acids, including short-, medium- and long-chain fatty acids that range in length from four to 24 carbons, with most of them being 12 to 18 carbons in length.[68] Stearic acid, containing 18 carbons, has no effect on LDL-C.[69] The other most common saturated fatty acids found in dairy fat (12, 14 or 16 carbons) raise blood levels of LDL-C, but also raise blood levels of high-density lipoprotein cholesterol (HDL-C) and lower triglycerides (compared to lower-fat, higher carbohydrate diets), a pattern associated with lower risk for CVD.[69,70] Dairy fat also contains small amounts of saturated fatty acids produced by rumen bacteria that contain 15 and 17 carbons, and these fatty acids are being studied for associations with health outcomes.[46,47] The complexity of dairy fat, which is part of the total food matrix of milk, cheese and yogurt, might help explain why the link between dairy food consumption and neutral or lower 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.

Are low-fat and fat-free dairy foods the only heathy choices?

Dairy foods are included in all healthy eating patterns in the DGA, as well as in recommended eating patterns from other authoritative bodies in the U.S.[71,72,73,74,75,76] and around the world.[77] The unique nutrient package of dairy foods helps meet nutrient recommendations and may help contribute to overall diet quality.[4] The DGA concluded that dairy consumption is associated with better bone health, especially among children and adolescents, and healthy eating patterns that include low-fat or fat-free dairy foods are linked to lower risk for certain chronic diseases, including CVD and type 2 diabetes.[2]

The link between saturated fat consumption and LDL-C has been a primary rationale for recommending low-fat or fat-free dairy foods. 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 like LDL-C. Emerging evidence indicates that dairy food consumption is not linked to higher risk for CVD, and in some cases is linked to reduced risk.[48] To understand the role of whole and reduced-fat dairy foods in healthy diets, more research is needed that compares the effects of low-fat and fat-free dairy foods with whole and reduced-fat dairy foods on cardiometabolic outcomes.[56] The additional calories contributed by whole and reduced-fat dairy foods can be addressed by moderate dietary changes.[55] This

growing evidence points to an emerging perspective that includes nutrient-rich dairy foods in healthy eating patterns because of their overall nutrient contributions and links to health, not based on their saturated fat content.

The evolution of the science on dietary saturated fat, dairy foods and CVD outcomes has been accompanied by calls to reassess dietary recommendations for dairy foods by various researchers during the last five years.[26,48,78,79,80] For example, in a comprehensive authoritative review, published in 2016, entitled Dietary and Policy Priorities for Cardiovascular Disease, Diabetes, and Obesity: A Comprehensive Review, Mozaffarian summarized current research on dairy foods this way, calling for "substantial further investment in research on cardiometabolic effects of dairy foods:"

> "No long-term studies support harms, and emerging evidence suggests some potential benefits, of dairy fat or high-fat dairy foods such as cheese. Together these findings provide little support for the prevailing recommendations for dairy intake that are based largely on calcium and vitamin D contents, rather than complete cardiometabolic effects; that emphasize low-fat dairy based on theorized influences on obesity and CHD, rather than empirical evidence; or that consider dairy as a single category, rather than separately evaluating different dairy foods."[26]

Drouin-Chartier, et. al., questioned current recommendations for low-fat or fat-free dairy foods in 2016:

> "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."[48]

Integrating learnings about the contributions to health of dairy nutrients, individual dairy foods and dairy foods as part of healthy, calorie-balanced eating patterns can make important contributions to our knowledge about the links between dairy food consumption and cardiovascular health.

Conclusion

The evidence supports a comprehensive assessment of dairy food consumption and cardiovascular health to inform future dietary guidance. The following characteristics of dairy foods may contribute to the overall effects of dairy foods on health:

- the unique nutrient contributions of milk and other dairy foods to healthy eating patterns
- the unique fatty acid profile of dairy fat
- the dairy food "matrix" or structure of individual dairy foods

To provide further insight, determining the effects of dairy food consumption on a variety of complex factors involved with CVD risk such as vascular function, insulin resistance, inflammation and blood lipid atherogenicity may be warranted.[26,70]

The DGA states that "a healthy eating pattern is not a rigid prescription, but rather, an adaptable framework in which individuals can enjoy foods that meet their personal, cultural and traditional preferences and fit within their budget."[2] This definition is consistent with flexibility to allow some whole or reduced-fat dairy foods in healthy eating patterns as defined by the DGA.

NOTE: This science summary is current through October 2017

References

[1] Dietary Guidelines Advisory Committee. 2015. Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2015, to the Secretary of Agriculture and the Secretary of Health and Human Services. Washington, DC: U.S. Department of Agriculture, Agricultural Research Service.

[2] U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015-2020 Dietary Guidelines for Americans. 8th Edition, December 2015. Available at http://health.gov/dietaryguidelines/2015/guidelines/.

[3] National Dairy Council. NHANES 2011-2014. Data Source: Centers for Disease Control and Prevention, National center for Health Statistics, National Health and Nutrition Examination Survey Data. Hyattsville, MD: U.S. Department of Health and Human Services. http://www.cdc.gov/nchs/nhanes.htm

[4] Fulgoni VL, 3rd, Keast DR, Auestad N, Quann EE: Nutrients from dairy foods are difficult to replace in diets of Americans: food pattern modeling and an analyses of the National Health and Nutrition Examination Survey 2003-2006. Nutr Res 2011, 31:759-765.

[5] Eckel RH, Jakicic JM, Ard JD, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology / American Heart Association Task Force on Practice Guidelines. Circulation 2014;129(25 Suppl 2):S76-99. http://circ.ahajournals.org/content/129/25_suppl_2/S76.long.

[6] Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, Sacks FM, Bray GA, Vogt TM, Cutler JA, Windhauser MM, et al. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. N Engl J Med 1997;336(16):1117-24. doi: 10.1056/NEJM199704173361601.

[7] Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, de Ferranti S, Despres JP, Fullerton HJ, Howard VJ, et al. Heart disease and stroke statistics-2015 update: a report from the American Heart Association. Circulation 2015;131:e29-e322.

[8] 1980 Dietary Guidelines for Americans: http://health.gov/dietaryguidelines/1980thin.pdf

[9] 1985 Dietary Guidelines for Americans: http://health.gov/dietaryguidelines/1985thin.pdf

[10] 1990 Dietary Guidelines for Americans: http://health.gov/dietaryguidelines/1990thin.pdf

[11] The Facts on Fats. 50 Years of American Heart Association Dietary Fats Recommendations. June 2015. Available at: http://www.heart.org/idc/groups/heart-public/@wcm/@fc/documents/downloadable/ucm_475005.pdf

[12] Food and Nutrition Board, Institute of Medicine. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients) (2005).

[13] U.S. Department of Health and Human Services and U.S. Department of Agriculture. Dietary Guidelines for Americans, 2005. 6th Edition, Washington, DC: U.S. Government Printing Office, January 2005.

[14] U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2010. 7th Edition, Washington, DC: U.S. Government Printing Office, December 2010.

[15] Lichtenstein AH, Appel LJ, Brands M, Carnethon M, Daniels S, Franch HA, Franklin B, Kris-Etherton P, Harris WS, Howard B, Karanja N, Lefevre M, Rudel L, Sacks F, Van Horn L, Winston M, Wylie-Rosett J. Summary of American Heart Association Diet and Lifestyle Recommendations revision 2006. Arterioscler Thromb Vasc Biol. 2006 26(10):2186-91.

[16] Van Horn L, Carson JA, Appel LJ, Burke LE, Economos C, Karmally W, Lancaster K, Lichtenstein AH, Johnson RK, Thomas RJ, Vos M, Wylie-Rosett J, Kris-Etherton P; American Heart Association Nutrition Committee of the Council on Lifestyle and Cardiometabolic Health; Council on Cardiovascular Disease in the Young; Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; and Stroke Council. Recommended dietary pattern to achieve adherence to the American Heart Association/American College of Cariology (AHA/ACC) guidelines: A scientific statement from the American heart Association. Circulation. 2016 Nov 29;134(22):e505-e529. Epub 2016 Oct 27. Erratum in: Circulation. 2016 Nov 29;134(22):e534.

[17] Sacks FM, Lichtenstein AH, Wu JHY, Appel LJ, Creager MA, Kris-Etherton PM, Miller M, Rimm EB, Robinson JG, Stone NJ, Van Horn LV. Dietary fats and cardiovascular disease. A presidential advisory from the American Heart Association. Circulation. 2017. DOI: 10.1161/CIR.0000000000000510.

[18] Siri-Tarino PW, Sun Q, Hu FB, Krauss RM. Saturated fatty acids and risk of coronary heart disease: modulation by replacement nutrients. Curr Atheroscler Rep 2010;12:384–390.

[19] Chowdury R, Warnakula S, Kunutsor S, Crowe F, Ward HA, Johnson L, Franco OH, Butterworth AS, Forouhi NG, Thompson SG, Khaw KT, Mozaffarian D, Danesh J, Di Angelantonio E. Association of dietary, circulating, and supplement fatty acids with coronary risk: a systematic review and meta-analysis. Ann Intern Med 2014;160:398-406.

[20] de Souza RJ, Mente A, Maroleanu A, Cozma AI, Ha V, Kishibe T, Uleryk E, Budylowski P, Schünemann H, Beyene J, Anand SS. Intake of saturated and trans unsaturated fatty acids and risk of all cause mortality, cardiovascular disease, and type 2 diabetes: systematic review and meta-analysis of observational studies. BMJ 2015;351:h3978.

[21] Dehghan M, Mente A, Zhang X, Swaminathan S, Li W, Mohan V, Iqbal R, Kumar R, Wentzel-Vilijoen E, Rosengren A, et al. Associations of fats and carbohydrates intake with cardiovascular disease and mortality in 18 countries from five continents (PURE): a prospective cohort study. Lancet. 2017 17:32252-32253.

[22] Jacobs DR, Tapsell LC. Food synergy: the key to a healthy diet. Proc Nutr Soc 2013;72:200-206.

[23] Hooper L, Martin N, Abdelhamid A, Davey Smith G. Reduction in saturated fat intake for cardiovascular disease. Cochrane Database of Systematic Reviews 2015, Issue 6. Art. No.: CD011737.

[24] Li Y, Hruby A, Bernstein AM, Ley SH, Wang DD, Chiuve SE, Sampson L, Rexrode KM, Rimm EB, Willett WC, Hu FB. Saturated fats compared with unsaturated fats and sources of carbohydrates in relation to risk of coronary heart disease a prospective cohort study. J Am Coll Cardiol 2015;66:1538-47.

[25] Jakobsen MU, Dethlefsen C, Joensen AM, Stegger J, Tjønneland A, Schmidt EB, Overvad K. Intake of carbohydrates compared with intake of saturated fatty acids and risk of myocardial infarction: importance of the glycemic index. Am J Clin Nutr 2010;91:1764–8.

[26] Micha R, Mozaffarian D. Saturated fat and cardiometabolic risk factors, coronary heart disease, stroke, and diabetes: a fresh look at the evidence. Lipids 2010 October; 45: 893–905.

[27] Mozaffarian D. Nutrition and cardiovascular disease and metabolic diseases. In: Mann DL, Zipes DP, Libby P, Bonow RO eds. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. 10th ed. Philadelphia, PA: Elsevier/Saunders; 2014.

[28] Mente A, Dehghan M, Rangarajan S, McQueen M, Dagenais G, Wielgosz A, Lear S, Li W, Chen H, Yi S, et al. Association of dietary nutrients with blood lipids and blood pressure in 18 countries: a cross-sectional analysis from the PURE study. Lancet 2017;17:30283-8.

[29] Dietary Guidelines Advisory Committee. 2010. Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010, to the Secretary of Agriculture and the Secretary of Health and Human Services. Washington, DC: U.S. Department of Agriculture, Agricultural Research Service.

[30] Larsson SC, Virtamo J, Wolk A. Dairy consumption and risk of stroke in Swedish women and men. Stroke 2012;43:1775-1780.

[31] Patterson E, Larsson SC, Wolk A, Akesson A. Association between dairy food consumption and risk of myocardial infarction in women differs by type of dairy food. J Nutr 2013;143:74-79.

[32] Sonestedt E, Wirfalt E, Wallstrom P, Gullberg B, Orho-Melander M, Hedblad B. Dairy products and its association with incidence of cardiovascular disease: the Malmo diet and cancer cohort. Eur J Epidemiol 2011;26:609-618.

[33] Dalmeijer GW, Struijk EA, van der Schouw YT, Soedamah-Muthu SS, Verschuren WM, Boer JM, Geleijnse JM, Beulens JW. Dairy intake and coronary heart disease or stroke-A population-based cohort study. Int J Cardiol 2013;167:925-929.

[34] Soedamah-Muthu SS, Ding EL, Al-Delaimy WK, Hu FB, Engberink MF, Willett WC, Geleijnse JM. Milk and dairy consumption and incidence of cardiovascular diseases and all-cause mortality: dose-response meta-analysis of prospective cohort studies. Am J Clin Nutr 2011;93:158-171.

[35] Hu D, Huang J, Wang Y, Zhang D, Qu Y. Dairy foods and risk of stroke: a meta-analysis of prospective cohort studies. Nutr Metab Cardiovas 2014;24:460-469.

[36] Qin L-Q, Xu J-Y, Han S-F, Zhang Z-L, Zhao Y-Y, Szeto IMY. Dairy consumption and risk of cardiovascular disease: an updated meta-analysis of prospective cohort studies. Asia Pac J Clin Nutr 2015;24:90-100.

[37] Soedamah-Muthu SS, Masset G, Verberne L, Geleijnse JM, Brunner EJ. Consumption of dairy products and associations with incident diabetes, CHD and mortality in the Whitehall II study. Br J Nutr 2013:109718-726.

[38] Louie JC, Flood VM, Burlutsky G, Rangan AM, Gill TP, Mitchell P. Dairy consumption and the risk of 15-year cardiovascular disease mortality in a cohort of older Australians. Nutrients 2013;5:441-454.

[39] van Aerde MA, Soedamah-Muthu SS, Geleijnse JM, Snijder MB, Nijpels G, Stehouwer CD, Dekker JM. Dairy intake in relation to cardiovascular disease mortality and all-cause mortality: the Hoorn Study. Eur J Nutr 2013;52:609-616.

[40] Bonthuis M, Hughes MC, Ibiebele TI, Green AC, van der Pols JC. Dairy consumption and patterns of mortality of Australian adults. Eur J Clin Nutr 2010;64:569-577.

[41] Kondo I, Ojima T, Nakamura M, Hayasaka S, Hozawa A, Saitoh S, Ohnishi H, Akasaka H, Hayakawa T, Murakami Y, Okuda N, Miura K, Okayama A, Ueshima H; NIPPON DATA80 Research Group. Consumption of dairy products and death from cardiovascular disease in the Japanese general population: the NIPPON DATA80. J Epidemiol 2013;23:47-54.

[42] Goldbohm RA, Chorus AM, Galindo Garre F, Schouten LJ, van den Brandt PA. Dairy consumption and 10-y total and cardiovascular mortality: a prospective cohort study in the Netherlands. Am J Clin Nutr 2011;93:615-627.

[43] Avalos EE, Barrett-Connor E, Kritz-Silverstein D, Wingard DL, Bergstrom JN, Al-Delaimy WK. Is dairy product consumption associated with the incidence of CHD? Public Health Nutr 2013;16:2055-2063.

[44] Praagman J, Franco OH, Ikram MA, Soedamah-Muthu SS, Engberink MF, van Rooij FJ, Hofman A, Geleijnse JM. Dairy products and the risk of stroke and coronary heart disease: the Rotterdam Study. Eur J Nutr 2014;54:981-90.

[45] de Oliveira Otto MC, Mozaffarian D, Kromhout D, Bertoni AG, Sibley CT, Jacobs DR, Nettleton JA. Dietary intake of saturated fat by food source and incident cardiovascular disease: the Multi-Ethnic Study of Atherosclerosis. Am J Clin Nutr 2012;96:397-404.

[46] de Oliveira Otto MC, Nettleton JA, Lemaitre RN, L MS, Kromhout D, Rich SS, M YT, Jacobs DR, Mozaffarian D. Biomarkers of dairy fatty acids and risk of cardiovascular disease in the multi-ethnic study of atherosclerosis. J Am Heart Assoc 2013;2:e000092.

[47] Warensjo E, Jansson JH, Cederholm T, Boman K, Eliasson M, Hallmans G, Johansson I, Sjogren P. Biomarkers of milk fat and the risk of myocardial infarction in men and women: a prospective, matched case-control study. Am J Clin Nutr 2010;92:194-202.

[48] Drouin-Chartier J-P, Brassard D, Tessier-Grenier M, Côté JA, Labonté M-È, Desroches S, Couture P, Lamarche B. Systematic review of the association between dairy product consumption and risk of cardiovascular-related clinical outcomes. Adv Nutr. 2016;7:1026-40.

[49] Guo J, Astrup A, Lovegrove JA, Gijsbers L, Givens D, Soedamah-Muthu SS. Milk and dairy consumption and risk of cardiovascular diseases and all-cause mortality: dose-response meta-analysis of prospective cohort studies. Eur J Epidemiol. 2017;32:269-87.

[50] Alexander DD, Bylsma LC, Vargas AJ, Cohen SS, Doucette A, Mohamed M, Irvin SR, Miller PE, Watson H, Fryzek JP. Dairy consumption and CVD: a systematic review and meta-analysis. Br J Nutr. 2016;115:737–750.

[51] Chen GC, Wang Y, Tong X, Szeto IMY, Smit G, Li ZN, Qin LQ. Cheese consumption and risk of cardiovascular disease: a meta-analysis of prospective studies. Eur J Nutr. 2017;56(8):2565-2575.

[52] Mullie P, Pizot C, Autier P. Daily milk consumption and all-cause mortality, coronary heart disease and stroke: a systematic review and meta-analysis of observational cohort studies. BMC Pub Health. 2016;16:1236-43.

[53] de Goede J, Soedamah-Muthu SS, Gijsbers L, Geleijnse JM. Dairy consumption and risk of stroke: a systematic review and updated dose-response meta-analysis of prospective cohort studies. JAHA. 2016;5:e002787.

[54] Department of Health and Human Services. Your Guide to Lowering Blood Pressure. Available at: https://www.nhlbi.nih.gov/files/docs/public/heart/hbp_low.pdf.

[55] Chiu S, Bergeron N, Williams PT, Bray GA, Sutherland B, Krauss RM. Comparison of the DASH (Dietary Approaches to Stop Hypertension) diet and a higher fat DASH diet on blood pressure and lipids and lipoproteins: A randomized controlled trial. Am J Clin Nutr 2016 Feb;103(2):341-347.

[56] Kratz, M, Baars T, Guyenet S. The relationship between high-fat dairy consumption and obesity, cardiovascular, and metabolic disease. Eur J Nutr 2013;52:1-24.

[57] Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. N Engl J Med 2011;364:2392–2424.

[58] Rautiainen S, Wang L, Lee IM, Manson J, Buring JE, Sesso HD. Dairy consumption in association with weight change and risk of becoming overweight or obese in middle-aged and older women: a prospective cohort study. Am J Clin Nutr. Epub ahead of print February 24, 2016 as doi: 10.3945/ajcn.115.118406.

[59] Santiago S, Sayón-Orea C, Babio N, Ruiz-Caela M, Martí A, Corella D, Estruch R, Fitó M, Aros F, Ros, E, et al. Yogurt consumption and abdominal obesity reversion in the PREDIMED study. Nutr Medtab Cardio Dis.

[60] Rosell M, Håkansson H, Wolk A. Association between dairy food consumption and weight change over 9 y in 19,352 perimenopausal women. Am J Clin Nutr. 2006:84:1481-8. Epub head of print December 12, 2015 as doi: 10.1016/j.numecd.2015.11.012.

[61] United States Department of Agriculture, National Agricultural Library.

[62] Thorning TK, Bertram HC, Bonjour J-P, de Groot L, Dupont D, Feeney E, Ipsen R, Lecerf JM, Mackie A, McKinley MC, et al. Whole dairy matrix or single nutrients in assessment of health effects: current evidence and knowledge gaps. Am J Clin Nutr 2017. DOI: 10.3945/ajcn.116.151548

[63] Huth PJ, Fulgoni VL 3rd, Keast DR, Park K, Auestad N. Major food sources of calories, added sugars, and saturated fat and their contribution to essential nutrient intakes in the U.S. diet: data from the National Health and Nutrition Examination Survey (2003-2006). Nutr J 2013;12:116-125.

[64] de Oliveira Otto MC, Mozaffarian D, Kromhout D, Bertoni AG, Sibley CT, Jacobs DR, Nettleton JA. Dietary intake of saturated fat by food source and incident cardiovascular disease: the Multi-Ethnic Study of Atherosclerosis. Am J Clin Nutr 2012;96:397-404.

[65] Raziani F, Thostrup T, Kristensen MD, Svanegaard ML, Ritz C, Astrup A, Raben A. High intake of regular-fat cheese compared with reduced-fat cheese does not affect LDL cholesterol or risk markers of the metabolic syndrome: a randomized controlled trial. Am J Clin Nutr 2016. DOI: 10.3945/ajcn.116.134932.

[66] De Goede J, Geleijnse JM, Ding EL, Soedamah-Muthu SS. Effect of cheese consumption on blood lipids: a systematic review and meta-analysis of randomized controlled trials. Nutr Rev 2015;73:259-275.

[67] Praagman J, Beulens JWJ, Alssema M, Zock PL, Wanders AJ, Sluijs I, van der Schouw YT. The association between dietary saturated fatty acids and ischemic heart disease depends on the type and source of fatty acid in the European Prospective Investigation into Cancer and Nutrition-Netherlands cohort. Am J Clin Nutr 2016;103(2):356-365.

[68] Mansson HL. Fatty acids in bovine milk fat. Food Nutr Res 2008. Epub 2008 Jun 11. DOI:3402/fnr.v52i0.1821.

[69] Mensink, RP, Zock, PL, Kester, ADM, Katan, MB. Effects of dietary fatty acids and carbohydrates on the ratio of serum total to HDL cholesterol and on serum lipids and apolipoproteins: a meta-analysis of 60 controlled trials. Am J Clin Nutr 2003;77: 1146–1155.

[70] Siri-Tarino PW, Chiu P, Bergeron N, Kraus RM. Saturated fats versus polyunsaturated fats versus carbohydrates for cardiovascular disease prevention and treatment. Ann Rev Nutr 2015;35:517-43.

[71] Van Horn L, Carson JA, Appel LJ, Burke LE, Economos C, Kamally W, Lancaster K, Lichtenstein A, Johnson RK, Thomas RJ: Recommended dietary pattern to achieve adherence to the American Heart Association/American College of Cardiology (AHA/ACC) Guidelines: a scientific statement from the American Heart Association. Circulation 2016, doi: 10.1161/CIR. 0000000000000462.

[72] Gidding SS, Dennison BA, Birch LL, Daniels SR, Gilman MW, Lichtenstein AH, Rattay KT, Steinberger J, Stettler N, Van Horn L. Dietary Recommendations for Children and Adolescents: A Guide for Practitioners. Pediatrics 2006; 117(2):544-59.

[73] Golden NH, Abrams SA, Committee on Nutrition: Optimizing bone health in children and adolescents. Pediatrics 2014, 134:e1229-1243.

[74] National Osteoporosis Foundation Website. Prevention and healthy living: food and your bones. http://nof.org/learn/prevention. Accessed on August 28, 2015.

[75] Weaver CM, Gordon CM, Janz KF, Kalkwarf HJ, Lappe JM, Lewis R, O'Karma M, Wallace TC, Zemel BS: The National Osteoporosis Foundation's position statement on peak bone mass development and lifestyle factors: a systematic review and implementation recommendations. Osteoporos Int 2016, 27:1281-1386.

[76] American Diabetes Association Website. Dairy. http://www.diabetes.org/food-and-fitness/food/what-can-i-eat/making-healthy-food-choices/dairy.html. Accessed on November 13, 2015.

[77] Food and Agriculture Organization of the United Nations (FAO). Food-based dietary guidelines. August 2015. http://www.fao.org/nutrition/education/food-dietary-guidelines/home/en/ Accessed on November 13, 2015.

[78] Lamarche B and Couture P. It is time to revisit current dietary recommendations for saturated fat. Appl Physiol Nutr Metab 2014;39:1409-1411.

[79] Mozaffarian D. Dietary and Policy Priorities for Cardiovascular Disease, Diabetes, and Obesity: A Comprehensive Review. Circulation 2016;133:187-225.

[80] Lawrence GD. Dietary fats and health: dietary recommendations in the context of scientific evidence. Adv Nutr 2013;4:294-302.