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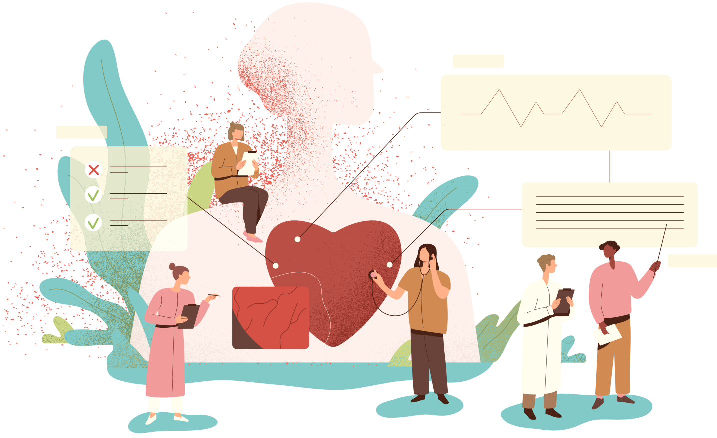
Literature suggests that dairy fat intake is associated with largely neutral or favourable cardiovascular outcomes, despite containing high amounts of saturated fatty acids. This review summarises recent findings on dairy consumption and cardiovascular health.

A publication for health professionals

Dairy & *cardiovascular disease*



The World Health Organization (WHO) estimates that, over the next 10 years, deaths from non-communicable diseases (NCDs) are likely to increase by 17% globally, and by 27% in the African region. According to the Global Burden of Disease report, ischemic heart disease will be the leading cause of death by 2050.[1] In South Africa, cardiovascular disease (CVD) is already the leading cause of death in the NCD group.[2]

Raised serum levels of low-density lipoprotein (LDL) cholesterol and triglycerides, together with a low level of high-density lipoprotein (HDL) cholesterol and high blood pressure, are known risk factors for CVD. In addition, lifestyle-related factors such as obesity, inactivity and smoking also contribute to the risk.[3] Intervention strategies for the prevention and treatment of CVD should focus on addressing all cardiometabolic risk factors, with a special focus on lowering LDL-cholesterol and blood pressure.[3]

The intake of saturated fatty acids (SFAs) generally results in raising LDL cholesterol, which increases the risk of atherosclerotic components and contributes to the development of CVD.[4,5] Current recommendations are to limit the intake of SFAs, as reducing the intake of SFAs has been linked to beneficial effects on cardiovascular-related mortality, total mortality and protection against stroke.[5,6] To that effect, most guidelines recommend that the intake of SFAs be limited to less than 10% of total energy intake.[4,5,7]

Although dairy fat contains up to 60% SFAs and dietary guidelines often recommend low-fat dairy to limit SFA intake,[4,5,7-9] the current body of evidence does not consistently support this. Literature suggests that dairy fat intake is associated with largely neutral or favourable cardiovascular outcomes, with limited evidence of harm. This review summarises recent findings on dairy consumption and cardiovascular health and considers factors that may contribute to these observed effects.

RESEARCH EVIDENCE REGARDING DAIRY INTAKE AND CARDIOVASCULAR HEALTH OUTCOMES

In a 12-year follow-up study on the association between dairy intake and all-cause mortality, CVD mortality and cancer risk, a 19% lower hazard was reported for all-cause mortality (hazard ratio, HR 0.81; 95% confidence interval, CI: 0.70–0.92) when the highest and lowest tertile for total dairy intake were compared. For milk intake, the hazard of all-cause mortality was 16% lower among women (HR

0.84; 95% CI: 0.73–0.95). Likewise, yoghurt intake was associated with a 13% lower hazard of all-cause mortality among women (HR 0.87; 95% CI: 0.76–0.99) and a 10% lower hazard among men (HR 0.90; 95% CI: 0.82–0.99). Yoghurt intake also reduced CVD hazard by 36% in women (HR 0.64; 95% CI: 0.46–0.90). A possible reason for the sex-specific differences found in this study was the difference in actual dairy intake, as women consumed an average of 235 g of dairy per day and men 170 g per day.[10]

An umbrella review of 33 meta-analyses regarding dairy consumption and the risk of CVD reported that both total dairy intake and milk consumption were associated with a 3% lower risk of CVD (total dairy: risk ratio, RR 0.97; 95% CI: 0.93–0.99; milk: RR 0.97; 95% CI: 0.94–1.0). Yoghurt intake was associated with an 8% lower risk of CVD (RR 0.92; 95% CI: 0.87–0.98). The risk of hypertension decreased by similar margins (3–13%) upon the intake of a number of different dairy products. The risk of stroke reduced with the intake of total dairy (13%; RR 0.87; 95% CI: 0.81–0.94), low-fat dairy (11%; RR 0.89; 95% CI: 0.84–0.95) and milk (10%; RR 0.90; 95% CI: 0.83–0.98), whereas the association between yoghurt intake and stroke was neutral (RR 1.0; 95% CI: 0.90–1.13).[11]

A systematic review and meta-analysis by Akyil et al.[12] showed that dairy consumption was linked to higher risk in only 4% of 281 health-related associations; 38% were associated with reduced risk, 48% of outcomes showed no association and associations were inconclusive for 10% of the identified outcomes. The intake of total dairy, milk, cheese and yoghurt either reduced the risk of CVD or resulted in no associations. Intake of fermented dairy products reduced risk in most studies, with only two reporting no associations. No reports linked dairy intake to increased risk of CVD.

A healthy diet score was developed based on data from the PURE study. Six food groups were included in the score: fruit (2–3 servings per day); vegetables (2–3 servings per day); legumes (3–4 servings per week); nuts (7 servings per week), fish (2–3 servings per week); and dairy, mainly whole fat (2 servings per day = 185.5 g per day). Participants, following this diet for an average of 8.5 years reported an 8% lower risk of death and a 6% lower risk of developing CVD events.[13]

Salehi et al.[14] determined the relationship between dairy consumption and risk factors for CVD, as well as the Framingham risk score (FRS) among women. The FRS is a gender-specific score of the 10-year risk for CVD. Both high- and low-fat dairy intake was associated with beneficial effects. Higher consumption of low-fat dairy resulted in a significantly lower FRS than with lower consumption. The highest cheese intake was associated with 65% lower odds of high fasting blood glucose levels (odds ratio, OR 0.35; 95% CI: 0.07–1.62) and 95% lower odds for high triglyceride levels (OR 0.05; 95% CI: 0.003–1.09). Consumption of high-fat dairy products was also inversely associated with LDL cholesterol levels (OR 0.19; 95% CI: 0.01–3.2). Consuming more yoghurt lowered the chance of having high triglyceride levels by 95% (OR 0.05; 95% CI: 0.003–1.09) and lowered the odds of high LDL cholesterol by 81% (OR 0.19; 95% CI: 0.01–3.2).

Performing a sub-analysis of the NHANES data (18 282 participants), Wu et al.[15] compared the effect of the intake of whole milk (3.5% fat), reduced-fat milk (2% fat) and low-fat milk (1% fat) with that of skimmed milk (<0.5% fat) on various CVD outcomes. Consuming whole milk rather than skimmed milk resulted in a 42% reduction prevalence of coronary heart disease (OR 0.58; 95% CI: 0.418–0.810). Similarly, intake of reduced-fat compared with skimmed milk resulted in a 34% reduced prevalence of coronary heart disease (OR 0.66; 95% CI: 0.502–0.890). The protective effect of whole milk on CVD was more pronounced among older individuals (□65 years). However, consumption of whole milk was associated with increased prevalence of stroke (OR 1.585; 95% CI: 1.023–2.457).

In a Norwegian study, 73 860 participants were followed for a period of 33 years to determine the relationship between milk intake and CVD, as well as all-cause mortality.[16] A comparison of the highest versus lowest quintiles of overall milk intake showed a 12% greater hazard for CVD mortality (HR 1.12; 95% CI: 1.03-1.21) and a 22% greater hazard for all-cause mortality (HR 1.22; 95% CI: 1.16–1.28) associated with higher intake.[16] The intake of low-fat milk compared with whole milk was associated with a 7% lower risk of CVD mortality (HR 0.93; 95% CI: 0.88–0.98) and an 11% lower risk of all-cause mortality (HR 0.89; 95% CI: 0.87–0.92).

Data from 450 507 participants (as included in the UK Biobank) and who have been followed up for a median of 12.1 years revealed a reduced hazard for developing CVD mortality linked with intake of both full-cream milk (7%; HR 0.93; 95% CI: 0.77–1.12) and low-fat or skimmed milk (26%; HR 0.74; 95% CI: 0.62–0.88).[17] With regard to all-cause mortality, intake of low-fat or skimmed milk reduced the event hazard by 18% (HR 0.82; 95% CI: 0.76–0.88); however, consumption of full-cream milk increased the hazard for developing all-cause mortality by 5% (HR 1.05; 95% CI: 0.97–1.14). The latter was mainly driven by the increased hazard ratio reported in women (20%; HR 1.20; 95% CI: 1.05–1.37).

Zhuang et al.[9] compared data from the UK Biobank with that from the China Kadoorie Biobank in a meta-analysis. For the Chinese data, regular intake of dairy (mainly whole milk; >4 times per week) was associated with an increased hazard of developing coronary heart disease (9%; HR 1.09; 95% CI: 1.05–1.13) and a 6% reduced hazard for developing stroke (HR 0.94; 95% CI: 0.91–0.97). The hazard of haemorrhagic stroke was 24% less (HR 0.76; 95% CI: 0.69-0.83). From the British data, regular intake of total dairy was found to have resulted in a reduced hazard of developing CVD (7%; HR 0.93; 95% CI: 0.88–0.98), coronary heart disease (7%; HR 0.93; 95% CI: 0.88–0.99) and stroke (14%; HR 0.86; 95% CI: 0.75–0.99).[9] The hazard of developing haemorrhagic stroke was 57% less (HR 0.43; 95% CI: 0.21-0.87) among regular milk consumers (>0.5 servings per day) compared with non-users. Yoghurt intake reduced the hazard for ischaemic stroke by 14% (HR 0.86; 95% CI: 0.77–0.98) in regular consumers (>0.5 servings per day) compared with non-users.[9]

Subgroup analysis showed that the inverse associations for dairy intake and CVD and stroke in both cohorts held only for men, those with hypertension and smokers.

The US National Institutes of Health's AARP Diet and Health Study included 407 531 men and 231 881 women. A 9% higher hazard was found for both overall and CVD mortality when the highest quintile of animal fat intake, including from dairy, was compared with the lowest quintile of intake. In contrast, higher intake of plant fats, especially fats from grains and vegetable oils, lowered risk.[18]

However, many factors can affect study results, and these should be considered when interpreting results. Importantly, various components dictate how food is digested, absorbed and metabolised in the body.[19] These include the dairy matrix, LDL-cholesterol particle size, degree of processing, level of fermentation and presence of inflammation, as well as dose–response relationships.

For a summary of the effect of dairy foods on various cardiovascular and mortality outcomes, also see Table 1.

Table 1: Effect of dairy foods on various cardiovascular and mortality outcomes

Food	Favourable outcomes					Neutral outcomes					Unfavourable outcomes				
	CVD prevalence	CVD mortality	Stroke	Hypertension	All-cause mortality	CVD prevalence	CVD mortality	Stroke	Hypertension	All-cause mortality	CVD prevalence	CVD mortality	Stroke	Hypertension	All-cause mortality
Total dairy	X 9,11-13,41	X 13	X 9,11,12,42	X 11,12,42	X 10	X 12,34,42		X 12,34	X 12		X 9	X 18			X 18
Low-fat dairy	X 15,42		X 11,42	X 11,42		X 34		X 34							
High-fat dairy			X 42	X 42		X 34		X 34			X 42				
Milk–full-fat/whole	X 9,11,15,38,41		X 9,11,12,34,38,42	X 11,12,38,42	X 10	X 12,34	X 17	X 12		X 17	X 16,42		X 15,38		X 16,17
Milk–Low-fat/skimmed		X 16,17			X 16,17										
Femen-ted dairy	X 12,39	X 12	X 12	X 12	X 40				X 12						
Cheese	X 12,34,39,42	X 40	X 42	X 42	X 40	X 12		X 34	X 12						
Yoghurt	X 10-12,39		X 9,12	X 11,42	X 10	X 12,34		X 11,34	X 12		X 42		X 42		

CVD = cardiovascular disease. Numbers in cells refer to the relevant references.

FACTORS IMPACTING OUTCOMES OF RESULTS

Dairy matrix[4]

The International Dairy Federation (IDF) defines the dairy matrix as 'the unique structure of a dairy food, its components (e.g. nutrients and non-nutrients), and how they interact'.[20]

The food matrix of dairy products is complex and includes fatty acids, protein (whey and casein), minerals (calcium, iodine, magnesium, sodium, potassium, phosphorus and zinc), the phospholipid component of the milk-fat globule membrane (MFGM), probiotics and vitamins (vitamin A, B2, B3, B5, B6, B12, D and K2).[6,9,11,21-24]

Owing to the complexity of the food matrix, it is not possible to ascribe the outcome of dairy intake to a single nutrient (e.g. SFAs) or assess the outcome with a single risk marker (e.g. the effect on LDL cholesterol). It is believed that interactions occur between nutrients in food and that the cumulative effects are more pronounced than that of individual nutrients.[19] It is therefore important not to focus on individual nutrients but rather on the full composition of the food item, as the complex food matrix dictates the combined effects of nutrients.[5,6]

According to the IDF, the health effects of the dairy matrix refer to 'the impact of a dairy food on health that extends beyond its individual components (e.g. nutrients and non-nutrients)'.[20] Figure 1 depicts the dairy matrix and its unique nutritional composition, including mechanisms by which the nutrients exert their health effects. The outer layer reflects the extent of the dairy matrix health effect.

Nutrient adequacy

The Nutrient-Rich Food Index score (NRF 9.3) considers nine nutrients deemed to have beneficial properties (protein, fibre, calcium, iron, potassium, magnesium, and vitamins A, D and E) and three nutrients that should be avoided (saturated fat, sodium and sugar). Drewnowski et al.[30] calculated the NRF 9.3 per serving size for various foods and plotted it against the energy density (kcal/100 g). Most dairy products fall into the category of highest nutrient density score and lowest energy density.

LDL-cholesterol particle size

Although the intake of SFAs from dairy products leads to an increases in LDL cholesterol, it increases the formation of larger LDL particles rather than small, dense particles. The former are less atherogenic and thus less strongly linked to CVD.[4,6,8] Having higher levels of smaller particles increase the risk of CVD owing to their lower ability to bind to LDL receptors, which makes them more susceptible to oxidation.

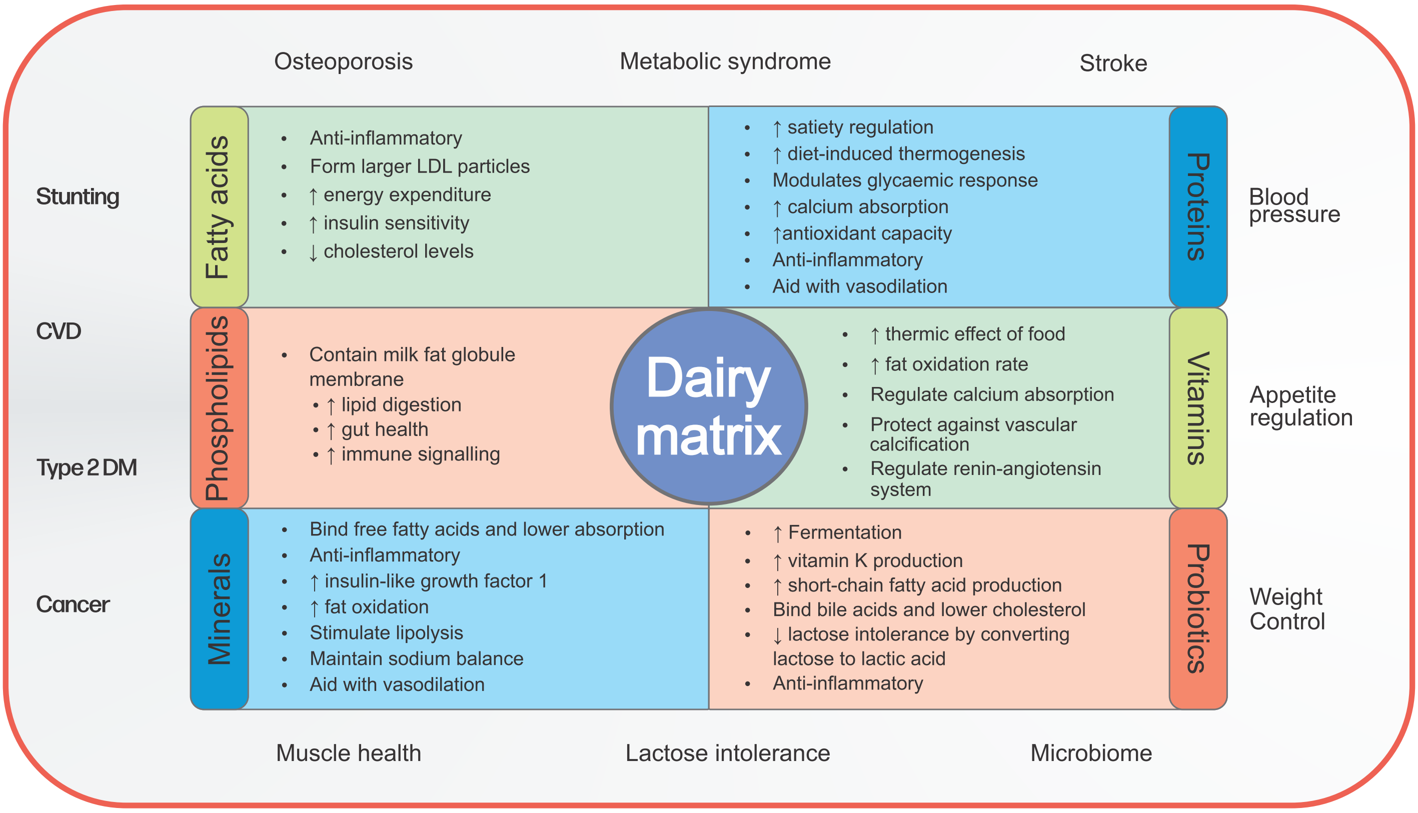


Figure 1: Dairy matrix health effect[4,7,11,12,19,22,24-29]

Processing of foods

Food processing affects the food matrix, which, in turn, affects the relationship between nutrients and health. Therefore, it is not only the interaction between individual components in foods but also processing that is important in the overall effect.[6]

Milk fat globules are surrounded by the MFGM, which contains various bioactive components, including milk polar lipids.[24] High-fat dairy contains high levels of MFGM, which protects fat globules from degradation by enzymes.[4] However, processing steps such as homogenisation and other mechanical treatments can disrupt or reduce the MFGM, leading to a decline in milk polar lipids. As many of the health-protective properties of milk are associated with the MFGM (e.g. reduction in intestinal cholesterol absorption and anti-inflammatory properties), processing may lead to these benefits diminishing.[7]

Intake of ultra-processed foods (e.g. sweetened dairy drinks) results in high energy densities and a low nutritional value, whereas natural or minimally processed products (cheese or yoghurt) increase the availability of the minerals calcium, potassium and magnesium, which contribute to lowering blood pressure. This effect of dairy is higher than that of other foods with comparable SFA content, probably mediated by the available minerals.[31]

Duration of intake

Brief consumption, irrespective of the type of dairy or fat content, is unlikely to produce significant effects, whereas long-term consumption of total dairy and low-fat dairy and milk is associated with a reduced risk of hypertension. Prolonged dairy intake also seems to have a favourable effect on plasma glucose levels and insulin resistance.[3] This was confirmed by a Cochrane review conducted by Hooper et al.[32] They reported a 21% lower risk of combined cardiovascular events (RR 0.79; 95% CI: 0.66–0.93), but a minimal effect on all-cause mortality (4% reduction; RR 0.96; 95% CI: 0.90–1.03).[32] They recommend a persistent reduction in SFA intake for at least two years to benefit from the reduced CVD risk effect.

Nutrient composition of replacement food

The effect of replacing SFAs depends on what food is used as replacement (also see Table 2 on the next page).[6]

- **SFA from dairy replaced with other fat:** Replacing calories from SFAs with equivalent calories from poly-unsaturated fatty acids resulted in a 27% risk reduction in CVD.[32] However, mixed results were reported when substituting whole-fat with low-fat dairy products.[33,34]
- **Dairy to carbohydrates:** Replacing SFAs with high-quality carbohydrates (e.g. whole grains) is associated with lower LDL cholesterol levels, a lower CVD risk and a decrease in all-cause mortality.[23,32,33] Replacing SFAs with high glycaemic-index carbohydrates (e.g. refined starches and sugar) appears to have no beneficial effects or may increase risk.[23]
- **Dairy to meat:** Substituting dairy with red meat or processed meat appears to increase the risk of all-cause mortality.[33]
- **Meat to dairy:** Studies showed that replacing 2.5% of energy from meat-derived SFAs with an equivalent amount of energy from dairy-derived SFA (total dairy, cheese, milk and yoghurt) resulted in significantly reduced hazards for developing CVD and coronary artery disease; however, mixed results were reported for stroke.[35] In women, the higher dairy SFA intake was associated with lower body mass index and a lower likelihood of hypercholesterolaemia.[35] The authors speculated that the beneficial effects of dairy consumption compared with meat could be due to the deleterious components found in meats (sodium, nitrates) and the positive effects of the dairy matrix.[35]

Substituting meat (total, red meat, processed meat) with various dairy components led to the biggest hazard reductions.[35] It is important to note that the nutritional profile of foods that are replaced by dairy is often different from that of dairy, which can result in a significant loss of important micronutrients.[4,7,36] A decrease in SFA intake can also result in a decrease in HDL cholesterol. Therefore, the net effect of changes to SFA intake should not be evaluated only by the effect on LDL cholesterol.[6]

Table 2: **Alternative food sources when SFAs from one food source have to be replaced**

Replacement food	Effect	Reference
Replacement of SFA with:		
Poly-unsaturated fatty acids	• 27% reduced risk for total CVD events (RR 0.73; 95% CI 0.58–0.92)	32
Carbohydrate	• 16% reduced risk for total CVD events (RR 0.84; 95% CI 0.67–1.06)	32
Replacement of low-fat dairy (200 g) with:		
Red meat (142 g)	• 11% increased risk for all-cause mortality (RR 1.11; 95% CI 1.06–1.16) • 8% increased risk for CAD (RR1.13; 95% CI 1.08–1.18)	33
Processed meat (30 g)	• 19% increased risk for all-cause mortality (RR 1.19; 95% CI 1.11–1.28)	33
Replacement of total dairy (200 g) with:		
Whole grains (23 g)	• 11% decreased risk for all-cause mortality (RR 0.89; 95% CI 0.84–0.93)	33
Replacement of yoghurt (200 g) with:		
Whole grains (23 g)	• 9% decreased risk for all-cause mortality (RR 0.91; 95% CI 0.85–0.97)	33
Milk (185 ml)	• 9% increased risk for all-cause mortality (RR 1.09; 95% CI 1.02–1.16	33
Replacement of whole-fat milk (200 ml) with:		
Low-fat milk (200 ml)	• 3% decreased risk for stroke (RR 0.97; 95% CI 0.91–1.04)	33
Cheese (20 g)	• 6% decreased risk for stroke (RR 0.94; 95% CI 0.88–1.00)	33
Replacement of low-fat milk with:		
High-fat milk	• 2% decreased risk for stroke (RR 0.98; 95% CI 0.91–1.05)	34
Replacement of low-fat yoghurt with:		
High-fat yoghurt	• 57% increased risk for stroke (RR 1.57; 95% CI 0.77–3.21)	34
Replacement of high-fat yoghurt with:		
Low-fat milk	• 41% decreased risk for stroke (RR 0.59; 95% CI 0.24–1.42)	34
Replacement of cheese with:		
Low-fat yoghurt	• 2% decreased risk for stroke (RR 0.98; 95% CI 0.87–1.11)	34
High-fat yoghurt	• 67% increased risk for stroke (RR 1.67; 95% CI 0.08–4.01)	34
Replacement of meat with:		
Total dairy	• 11% lower hazard of CVD (HR 0.89; 95% CI: 0.82–0.96) • 12% lower hazard of CAD (HR 0.88; 95% CI: 0.80–0.96)	35
Replacement of processed meat with:		
Cheese	• 23% lower hazard of CVD (HR 0.77; 95% CI: 0.68–0.88) • 23% lower hazard of CAD (HR 0.77; 95% CI: 0.66–0.90) • 19% lower hazard of stroke (HR 0.81; 95% CI: 0.67–0.99)	35
Milk	• 16% lower hazard of CVD (HR 0.84; 95% CI: 0.75–0.94)	35
Replacement of red meat with:		
Cheese	• 14% lower hazard of CVD (HR 0.86; 95% CI: 0.76–0.97)	35
Milk	• 7% lower hazard of CVD (HR 0.93; 95% CI: 0.83–1.04)	35
Replacement of poultry with:		
Milk	• 55% higher hazard of CVD (HR 1.55; 95% CI: 1.03–2.33) • 106% higher hazard of stroke (HR 2.06; 95% CI: 1.09–3.89)	35
Yoghurt	• 62% higher hazard of CVD (HR 1.62; 95% CI: 1.02–2.56) • 155% higher hazard of stroke (HR 2.55; 95% CI: 1.27–5.13)	35
Cheese	• 44% higher hazard of CVD (HR 1.44; 95% CI: 0.96–2.17) • 96% higher hazard of stroke (HR 1.96; 95% CI: 1.04–3.70)	35

HR = hazard ratio; RR = relative risk; CI = confidence interval; CVD = cardiovascular disease; CAD = coronary artery disease

Role of inflammation

Low-grade inflammation, due to an increased level of pro-inflammatory cytokines, has been linked to the development of CVD, metabolic syndrome and type 2 diabetes.[7,21,37] Inflammation triggers physiological processes with local and systemic implications. This results in vascular and atheromatous changes.[37]

Long-chain SFAs such as palmitic acid (C16:0) and stearic acid (C18:0) found in milk have pro-inflammatory effects.[7,23] Although long-chain SFAs are found in abundance in dairy products, the pro-inflammatory effects are probably neutralised by other dairy components as intake of dairy results in a neutral or anti-inflammatory effect on inflammation.[5]

A systematic review, which included 27 randomised controlled trials, showed that dairy products and dairy proteins had a neutral to beneficial effect on inflammatory biomarkers. Inflammatory biomarkers (e.g. C-reactive protein and interleukin-6) were inversely correlated with CVD risk and anti-inflammatory cytokines (e.g. interleukin-10 and adiponectin) were positively correlated. The beneficial effects were more pronounced in overweight and obese populations.[21] The dairy matrix, with vitamin D, calcium and protein suppressing inflammation, and the interaction between the dairy matrix and the gut mucosal layers strengthening the barrier function and preventing bacterial translocation, were noted as possible mechanisms of action for the protective effect of dairy intake on inflammation. [21]

Level of fermentation

Intake of fermented dairy products is associated with reduced inflammatory markers.[4] Platelet-activating factor (PAF) is a pro-inflammatory phospholipid and dairy contains PAF inhibitors. As the level of fermentation increases, PAF inhibitor activity increases.[37] In addition, probiotics in fermented products can regulate the formation of atherosclerotic plaques and in individuals with hypercholesterolaemia, intake of dairy products with probiotics tends to improve plasma lipid levels.[5,7] Fermented dairy products also contain calcium (which binds free fatty acids), high-quality protein (which helps with appetite control owing to reduced secretin secretion, increased satiety and diet-induced thermogenesis, which increases plasma amino acid levels quicker due to fast digestion). This results in blood glucose regulation and early satiety.[38] Fermented foods are considered a good source of vitamin K, especially vitamin K2 (menaquinones).[9] The latter is associated with beneficial effects on cardiovascular health and protects against vascular calcification.[23,37]

Bacterial fermentation, which results in the production of SFAs, especially butyrate, also improves human gut health.[4,7-9,12,19,22] Fermentation increases shelf-life and improves digestibility and absorption of foods, contributing to better food security. Fermentation also increases bioavailability of nutrients and converts lactose to lactic acid, thus assisting with improving lactose tolerance.[22]

The impact of consuming fermented dairy products on 20-year CVD incidence was investigated in the ATTICA study.[39] Consuming more than two servings of fermented dairy products per day resulted in a 1.5 times lower overall risk of CVD. The effect was stronger for those with inflammation (raised C-reactive protein levels), with consumption of one serving of fermented dairy per day lowering the risk of developing CVD by 25%.[39]

Consumption of fermented dairy products over a 23-year period was associated with positive outcomes. For example, intake of 20 g of high-fat cheese per day (>20% fat) was inversely associated with CVD mortality (HR 0.96; 95% CI: 0.93–0.99) and all-cause mortality (HR 0.97; 95% CI: 0.96–0.99).[40] Similarly, the intake of low-fat fermented milk was inversely associated with all-cause mortality where every 250 g increase/day resulted in 9% reduced mortality hazard (HR 0.91; 95% CI: 0.85-0.97). This study showed beneficial effects on all-cause mortality for the intake of both high- and low-fat cheese, as well as of low-fat fermented milk.[40]

The correlation between intake of dairy products, specifically milk, and risk reduction in CVD is brought about through the anti-inflammatory properties of fermented dairy products and has been found to be more pronounced in women than men.[41]

Dose–response effect

A systematic review of meta-analyses with regard to the relationship between dairy food consumption and CVD endpoints revealed a dose–response effect for most products. In healthy individuals with normal serum cholesterol levels, a total dairy intake of up to 200 g per day, either as full-fat or low-fat products, was not associated with an increased incidence of CVD or related mortality. A slight trend towards increased risk was found when this amount was exceeded. A neutral association was found for milk intake up to 200 ml per day. Inverse associations were found for fermented products, with a yoghurt intake of 200 g per day and cheese consumption of up to 50 g per day being associated with lower risks. Based on these findings, consumption of up to 200 g of dairy foods per day, irrespective of fat content, is allowed for healthy individuals. Emphasis should be placed on fermented products.[5]

Using the Global Dietary Database, Ma et al.[41] found that total dairy intake decreased the odds of developing CVD by 4% (OR 0.94; 95% CI 0.92–1.0). More specifically, regular milk intake (1–6 times per week versus less than once per week) decreased the odds of developing CVD by 17% (OR 0.83; 95% CI 0.73–0.94). The authors reported that the frequency of intake had a stronger effect on CVD risk reduction than the fat content of the products.[41] Chen et al.[42] reported cardiovascular risk reductions with modest increases in dairy intake. Increasing total dairy intake with one serving per day resulted in a 4%, 2% and 4% decreased risk for CVD, hypertension and stroke, respectively.

In contrast, Arnesen et al.[16] reported the hazard for all-cause mortality increasing by 4% with every 100 g more milk consumed per day, while a similar intake of low-fat milk was associated with a 2% lower hazard for all-cause mortality. They reported no differences between men and women regarding the effect of overall milk intake; however, for whole-milk intake, the association with mortality was stronger for women and those with a body mass index <25 kg/m^2. Jakobsen et al.[34] also reported an 8% increased risk for coronary artery disease for every 200 g increase in consumption of high-fat dairy, whereas a 20 g per day increase in cheese intake reduced risk of CVD by 4%.

The concept of a threshold effect is postulated, whereby individuals with a deficiency for a specific nutrient (e.g. calcium) will benefit from dairy intake, with little or no effect seen in those with adequate nutrient status.[43]

Conclusion

Available evidence shows that total dairy intake has a protective to neutral effect on CVD risk for the most part. In addition, for healthy individuals, no harmful effects are associated with total dairy consumption of up to 200 g per day, irrespective of the fat content. Emphasis should also be placed on consumption of fermented foods.

Studies have yielded varying results regarding the effect of dairy intake on the risk of developing CVD. It is believed that interactions occur between nutrients in food and that the cumulative effects are more pronounced than that of individual nutrients. Some of the factors that may influence the findings of these studies include the type of fat, duration of intake and the synergistic effect of the food matrix. Recommendations should thus not focus on individual fatty acids or specific food groups, as the food matrix differs between foods.[4] Therefore, current dietary guidelines have moved away from nutrient-based approaches and now advocate for food-based dietary patterns, which consider the effect of the overall diet on health rather than focus only on the effect of individual nutrients. It is therefore encouraging to see that the new Mediterranean Lifestyle Pyramid for children and youth to prevent obesity and associated cardiovascular diseases suggests three to four servings of dairy foods per day, irrespective of fat content.[44]

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