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Nutritious by nature

The science behind
the health and nutritional impact
of milk and dairy foods

Cardiovascular disease

The focus on dairy foods and cardiovascular disease (CVD) is often in relation to saturated fat. There is an assumption that because some dairy foods contain saturated fatty acids and dairy in general contributes to saturated fat intake in the diet, that it also increases the risk of cardiovascular disease. Yet the majority of epidemiological studies have shown no adverse effects of regularly consuming milk and dairy foods such as yogurt and cheese on cardiovascular health, irrespective of fat content. In fact, in some cases a cardio-protective effect has been observed.

The explanation for this may lie in the complex composition of milk and dairy foods which, in addition to saturated fat, contain other nutrients and bioactive components such as calcium, potassium, vitamin K and bioactive peptides in the dairy matrix which may be beneficial to cardiovascular health. In addition, the overall fatty acid profile of milk and dairy may not have the detrimental effect on blood lipids or other cardiovascular parameters that has been assumed.

Observational studies

Ideally, the relationship between dairy foods and cardiovascular disease would be measured by very large, very long-term intervention trials. In practice, however, the best available data are often from large, long-term observational studies. There are several studies of this type in European populations dating back over a number of years. These give an indication of the potential health effects of milk and dairy foods in relation to the particular amounts, types and patterns of consumption in Europe. For example, a prospective cohort study from the UK reports that men who drank the most milk (around a pint / 586ml of whole milk a day) had fewer heart attacks and fewer strokes than those who had little or no milk in their diets[1]. The large Netherlands Cohort Study, consisting of over 120,000 men and women, showed no association between total milk product consumption and stroke mortality, although butter and dairy fat was associated with a small (7%) increased risk of all-cause and heart disease mortality among women[2]. Data from the smaller Dutch Hoorn Study also found that overall dairy intake was not associated with CVD mortality but the intake of high-fat dairy products was[3]. In contrast, the Rotterdam Study reports that in an older Dutch population, high-fat dairy was associated with a reduced risk of fatal stroke; total dairy consumption or the intake of specific dairy products was not related to CVD events[4].

In another Dutch prospective cohort, there was again no evidence that dairy products increased risk of heart disease or stroke[5]. In fact, high intakes of total and low-fat dairy were associated with a lower coronary heart disease (CHD) risk in participants without hypertension. Low-fat dairy consumption was also associated with reduced risk of stroke in cohorts of Swedish men and women[6]. In the same cohorts, a high intake of fermented milk (yogurt and cultured sour milk) was found to reduce CVD risk[7]. Fermented milk and cheese were also associated with reduced cardiovascular disease mortality[8]. There was, however, an increased CVD mortality risk reported in this study in those drinking three or more glasses of (non-fermented) milk a day compared with less than one glass. The reason for this discrepancy in the same cohort is not clear and the authors urge a cautious interpretation of the results. Moreover, when these data were re-examined, milk consumption was associated with

a lower risk of CVD mortality[9]. In line with the majority of epidemiological studies, a Danish investigation reports no adverse effects of dairy on cardiovascular health[10]. The French MONICA project conducted over 14 years, found that dairy consumption (particularly milk intake) as part of a diverse, healthy diet was associated with the lowest mortality rate mostly due to reduced cardiovascular deaths[11]. Similarly, in the large French prospective cohort NutriNet-Santé, dairy product consumption was not associated with total CVD or CHD risks, and furthermore consumption of fermented dairy, such as cheese and yogurt, was associated with a 19% reduction in the risk of cerebrovascular disease[12]. The findings of the large cohort PURE-study which included 136,384 individuals from 21 countries and 5 continents, demonstrated that dairy consumption (predominantly milk and yogurt) was associated with lower risk of mortality and major CVD events[13].

Meta-analyses for milk

A number of analyses have pooled the data from individual prospective studies such as these and their results strengthen the evidence that regularly consuming milk and other dairy products does not increase risk of cardiovascular disease and may even have a protective effect[1,14-26]. In relation to milk, an overview conducted in 2010 concluded that milk drinking is not harmful and may be associated with a small but worthwhile reduction in risk of coronary heart disease (8%) and a more substantial reduction in stroke risk (21%) for those who drank the most milk compared with those who drank the least[15]. The pooled results of seventeen studies in 2011 also found milk intake was associated with a small potential reduction in overall cardiovascular risk of 6% for each 200ml of milk consumed a day[16]. This analysis found no association between high intakes of either regular-fat or low-fat dairy products and increased risk of death from cardiovascular disease. Similarly, systematic reviews in 2015 and 2017 examining milk consumption and cardiovascular disease mortality observed no consistent association[17,18]. This was also the conclusion for milk and CVD risk in a meta-analysis published in 2016; milk intake was found to be neutral with respect to risk of stroke and coronary artery disease[19]. In a 2021 analysis of six studies comparing the those with the highest regular-fat milk consumption with the lowest, a greater risk of CHD was observed. However, for milk intake overall, those in the highest consumption group had a reduced risk of ischemic stroke compared with those in the lowest[20].

Meta-analyses for dairy products

Meta-analyses also support neutral or beneficial effects of other dairy foods on cardiovascular disease. Twenty-two prospective cohort studies were included in an analysis published in 2015 which examined stroke and CHD incidence in relation to intake of individual dairy foods, and to low- and regular-fat dairy[21]. Cheese consumption was associated with a 16% decreased heart disease risk, and both cheese and low-fat dairy foods were associated with reduced risk of stroke (9% and 7% respectively). An earlier meta-analysis in 2014 looking specifically at stroke also reported similar reductions in risk with low-fat dairy (9%) and cheese intake (6%) and, in addition, with total dairy (12%) and fermented milk (20%)[22]. Similarly, in another meta-analysis including 18 studies which had examined dairy intake and stroke risk, milk and cheese consumption were associated with reduced risk of stroke; risk reductions were maximal around 125g/day for milk (16%) and from 25g/day upwards for cheese (9%)[23]. Cheese was also associated with a lower risk of stroke (13%) in a meta-analysis published in 2016, as was total dairy intake (9%)[24]. In addition, cheese intake was associated with an 18% reduced risk of coronary heart disease. A beneficial effect of cheese was supported by a meta-analysis of prospective cohort studies published in 2017 in which cheese intake was associated with 10%, 14% and 10% reduced risks of total CVD, CHD and stroke respectively[25]. The dose-response analysis suggested that the 'optimum' cheese consumption is about 40g/day.

A lower risk of CHD was observed in a newly published meta-analysis comparing the highest with the lowest category of cheese intake[20]. Analyses of dairy product consumption in 13 studies also found lower CVD for women (13% reduction in risk with high dairy intake) but not for men[26]. A systematic review of the association between dairy product consumption and risk of various cardiovascular-related clinical outcomes reports favourable associations between intakes of total dairy, low-fat dairy,

cheese, and fermented dairy and the risk of stroke[19]. Similarly, a recent dose-response meta-analysis combining data from 29 prospective cohort studies demonstrated neutral associations between dairy products and cardiovascular mortality[18].

Potential dairy matrix mechanisms

The explanation for the finding that dairy foods, even those containing fat and saturated fat such as cheese, have a neutral or even a beneficial effect on CVD is likely to lie in the complex structural and nutritional composition of the dairy matrix[27].

Although some dairy foods contain saturated fatty acids, they are also rich in nutrients and bioactive components such as **calcium, potassium, phosphorus and bioactive peptides** that may modify CVD risk through, for example, positive effects on blood pressure, weight and diabetes. In addition, dairy constituents may have direct beneficial effects on cardiovascular parameters, which may help counter any negative impact of saturated fat in dairy on blood lipids and CVD risk. Bioactive peptides, for example, can affect blood clotting, arterial stiffness, endothelial function and inflammation[28]. Similarly, it is suggested that vitamin K2 (menaquinone; a form of vitamin K produced by bacteria such as those involved in food fermentation, and so found in fermented dairy, particularly cheese) may reduce CVD risk through effects on inflammation, blood calcium regulation and clotting[29].

Moreover, interactions of the components and structure of the dairy matrix including calcium, phosphorus, the milk fat globule membrane and starter cultures, have been shown to modify saturated fatty acid-induced increases in blood lipids[27, 30]. There is evidence that **calcium** in dairy foods, through its effects on binding fat and decreasing its absorption in the gut, may reduce the potential rise in LDL cholesterol following saturated fat consumption[31-33]. For example, cheese does not increase LDL cholesterol compared with butter of equal fat content[32]. Similarly, compared with a low-calcium control diet, milk- and cheese-based diets lessened saturated fatty acid-induced increases in total and LDL cholesterol[34]. It may be important for this beneficial effect that fat and calcium are embedded in the same food matrix, as is the case for milk and cheese[27]. In fact, a recent randomized controlled trial found that dairy fat, eaten in the form of cheese, appeared to affect blood lipids differently compared with the same constituents eaten in separate matrices, with significantly lower total cholesterol observed when all nutrients were consumed within the cheese matrix[30].

Phosphorus in the dairy matrix may also interact with calcium to influence blood lipids; calcium phosphate binds bile acids and fatty acids, and increases their excretion[35]. It has been suggested too that the membrane which encloses milk fat (the **milk fat globule membrane**; MFGM) and which is rich in bioactive phospholipids and proteins may have a beneficial role in modulating blood lipids[36, 37]. Fermented dairy foods may also modify blood lipids through favouring gut bacteria which produce short-chain fatty acids (SCFA), and which in turn have a positive effect on lipids[38]. The structure and texture of dairy food matrices can also influence digestion kinetics and uptake of lipids; the physical structure of cheese, for example, can slow fat digestion[39].

It is also increasingly recognised that individual saturated fatty acids have different effects on blood lipids; several of those in milk fat do not have an adverse effect on LDL ('bad') cholesterol or other markers of CVD risk including HDL ('good') cholesterol and the ratio of total to HDL cholesterol[40]. In addition, the total fatty acid profile of a food, not just its saturated fatty acid content, is important. Milk fat includes a number of fatty acids which may have beneficial effects on CVD risk factors such as blood lipids and markers of inflammation. These include conjugated linoleic acid (cis-9, trans-11 CLA) and trans palmitoleic acid (trans-C16:1)[41-43].

It is evident that in terms of the effects of milk and dairy foods on cardiovascular health, the whole food, and the dietary pattern, rather than an individual component such as saturated fat should be taken into account. In this respect, the weight of evidence suggests no adverse effects of regularly consuming milk and dairy foods on cardiovascular health and rather, in some studies, a cardio-protective effect has been observed.

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