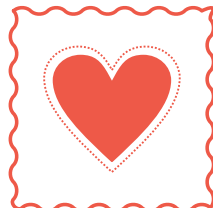




Dairy and hypertension



In view of the high prevalence and major implications of hypertension, attempts to decrease blood pressure are justified.¹⁻³ Although a fairly large body of observational evidence has suggested an association between consumption of dairy products and reduction in blood pressure,⁴⁻⁶ other studies have shown no association.⁷⁻⁹ Two meta-analyses of prospective cohort studies concluded that dairy intake was associated with lower systolic blood pressure and a lower risk of hypertension.^{2,3} Fat-free and low-fat dairy products, especially milk, appear to have an even more significant effect on lowering blood pressure than other dairy products.^{3,10} In addition, fermented dairy products with probiotics, such as yoghurt, have been shown to significantly reduce blood pressure.^{11,12}

As confounding is a limitation of observational studies, randomised controlled intervention trials are required to investigate causality. However, in the case of milk intake, interventions need to be implemented over a long period to investigate the association between milk intake and a health outcome such as hypertension. This is often not realistic. As an alternative, Mendelian randomisation studies are useful to investigate the association indirectly but in a similar way as in a randomised controlled intervention trial. With this approach, a genetic variant is used as a surrogate for exposure to milk products.¹³ A recent Mendelian randomisation study reported that genetically determined dairy consumption (including all dairy products, also ice-cream and cream), was not associated with an increase in systolic blood pressure or risk of hypertension.¹

The possible beneficial effect of dairy consumption on blood pressure appears to be derived from the complete nutritional profile of dairy products and not solely from calcium.^{2,3} The combination of minerals, vitamins, proteins and essential fatty acids, as well as the specific peptide sequences of dairy, contribute to this effect. Although pharmacological treatment of hypertension is effective in many patients, it might be inconvenient, expensive and accompanied with adverse effects in others. Based on the evidence, increased consumption of low-fat dairy foods may have either a beneficial or no effect on blood pressure, while dairy products that contain probiotics can significantly reduce blood pressure.

The evidence

Studies that support an association between consumption of dairy products and lower blood pressure

The most well-known randomised controlled trial related to diet and hypertension is the so-called DASH trial, which showed that dietary interventions can effectively impact on blood pressure, to the same extent or more as single-drug therapy.¹⁴ A diet rich in fruit, vegetables and low-fat dairy products, combined with lower intakes of total and saturated fats over a period of eight weeks, resulted in a significant decrease in blood pressure compared with that of subjects on a typical American control diet (5.5 mmHg reduction in systolic blood pressure; 3.0 mmHg reduction in diastolic blood pressure).¹⁵ Similarly, a meta-analysis of 14 clinical trials showed that probiotic-fermented milk, including yoghurt, resulted in a statistically significant reduction in systolic blood pressure.¹¹

A local study by Charlton et al.,¹⁶ which included 325 participants (men and women) from three different ethnic groups in Cape Town, showed that dietary calcium intake was inversely associated with both systolic and diastolic blood pressure.

A meta-analysis of five cohort studies, involving nearly 45 000 subjects of whom 11 500 had elevated blood pressure, showed significant inverse associations between blood pressure and the intake of total dairy, low-fat dairy and fluid dairy foods (milk and yoghurt).²

Soedamah-Muthu et al.³ performed a dose-response meta-analysis of prospective cohort studies that evaluated dairy intake and risk of hypertension in 57 256 subjects (of whom 15 367 were hypertensive). Participants were followed up for between 2 and 15 years. In their analysis, intake of total dairy, low-fat dairy and milk was each linearly associated with a lower risk of hypertension.

In these meta-analyses, the intake of high-fat dairy products (including whole milk, cream and cream cheese) and low-fat dairy products (including skimmed milk and yoghurt) showed inconsistent associations with systolic blood pressure. The inverse association was due mainly to consumption of low-fat dairy products.^{2,3}

Studies that support no association between consumption of dairy products and lower blood pressure

The Mendelian randomisation study of Ding et al.¹ concluded that genetically determined dairy consumption was not associated with increased systolic blood pressure or risk of hypertension. This study included participants from 32 studies (22 observational studies in the CHARGE* consortium and 10 previously published cohort studies). A total of 197 332 participants were observed. Of the 22 observational studies, nine were conducted in the US, nine in northern European countries three in southern European countries and one in Australia. Dairy products included skimmed (low-fat) milk, whole milk, ice cream, yoghurt, cottage or ricotta

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cheese, cream cheese, other cheese and cream. All these products were included in calculating total dairy consumption.

As lactase persistence is inherited as a dominant trait, the researchers used dominant models (*CC* vs *CT/TT* genotypes) to examine associations of the lactase persistence gene variant *LCT-13910 rs4988235* with dairy intake, systolic blood pressure and risk of hypertension, adjusting for possible confounders. The *CC* genotype is associated with complete lactase deficiency, whereas the *TT* genotype is associated with lactose persistence, and the *CT* genotype is associated with some lactase deficiency. Compared with the *CC* genotype, the *CT/TT* genotype of *LCT-13910 rs4988235* was associated with higher dairy consumption but not with systolic blood pressure or risk of hypertension.¹

Possible reasons for the inconsistent findings between the observational studies and the Mendelian randomisation study may relate to total dairy intake being assessed in the Mendelian study, while the inverse association seen in observational studies was due mainly to consumption of low-fat dairy products. Furthermore, the inverse association between the intake of specific dairy products (such as yoghurt) or probiotics and hypertension in clinical trials^{11,12} may be related to antihypertensive effects of probiotics or specific nutrients (such as milk peptides) in some dairy products. As dairy products such as yoghurt constituted only a small proportion of the total dairy products in the Mendelian study, its positive effects may have been masked. Consumption of dairy foods with a low lactose content, such as yoghurt or Mozzarella cheese, may not be affected by lactase persistence to the same degree as for other lactose-containing dairy foods. Finally, a high intake of low-fat dairy may be associated with a healthy diet and lifestyle, introducing a certain degree of confounding in observational studies.¹⁷

In addition to their Mendelian randomisation study, Ding et al.¹ also conducted a meta-analysis of eight randomised clinical trials, which included 735 participants, to determine the impact of dairy consumption on systolic blood pressure over 1–12 months of intervention. When comparing intervention with control groups, they found that dairy intake did not result in significant changes in systolic blood pressure.¹

Mechanisms

The association between dairy products and blood pressure is stronger than the association between calcium intake and blood pressure, suggesting that other components in dairy products may also have a role in this association.^{10,18}

Dairy products are usually low in sodium (cheese excluded) and rich in protein, minerals (calcium, magnesium, potassium and phosphorus), vitamins (riboflavin and also vitamin D in fortified milk) and trace elements (iodine, selenium and zinc). These factors may contribute to reduced blood pressure individually or in combination.^{10,19} The lowering effects of single nutrients on blood pressure may be too small to detect in primary clinical trials, but when consumed together, their combined effect may be sufficient to be detected and manifest as protective effects. It is also possible that there may be some unrecognised ingredients in dairy products that could affect blood pressure.²⁰

Clinical trials also showed that tripeptides and peptides derived from milk have hypotensive effects in prehypertensive and hypertensive participants,²¹ and that the bioactive milk peptides in dairy, such as lactotripeptides, may contribute to the protective effect of dairy on blood pressure. These bioactive peptides are released from dairy products after fermentation during food processing or digestion in the small

intestine^{2,19,22,23} and are hypothesised to inhibit the action of angiotensin 1-converting enzyme (ACE) and so prevent blood vessel constriction. ACE is a key participant in the renin–angiotensin system, which is a primary regulator of blood pressure and fluid and electrolyte balance in the body. ACE converts inactive angiotensin I to angiotensin II, which increases blood pressure by constricting vascular smooth muscle.²³ ACE inhibition lowers the production of angiotensin II, which, in turn, inhibits the release of aldosterone. As aldosterone conserves sodium, increases potassium loss and increases water retention, inhibiting aldosterone secretion decreases blood pressure.

Conclusion

Consumption of fermented dairy products may significantly reduce blood pressure, while that of low-fat dairy may be associated with a beneficial or neutral effect.



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