

Dairy: A lower percent investment in the volatile hypertensive environment

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Abstract

In cross-sectional and intervention studies, low-fat dairy has proven to be effective in lowering blood pressure in a hypertensive population. Contributing mechanisms include the angiotensin-converting enzyme-inhibiting effects of peptides and possible interplay between

calcium and vitamin D. Easily added to the diet, low-fat dairy is an attractive addition to nutritional, lifestyle, and pharmacological interventions to treat hypertension.

Key words: Dairy; Blood pressure; Hypertension; Milk; Cardiovascular

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Core tip: Low-fat dairy has shown to be effective in lowering blood pressure in a hypertensive population. Contributing mechanisms include the angiotensin-converting enzyme-inhibiting effects of peptides and possible interplay between calcium and vitamin D. Easily added to the diet, low-fat dairy is an attractive addition to nutritional, lifestyle, and pharmacological interventions to treat hypertension.

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BRIEF REVIEW: LOW-FAT DAIRY AND HYPERTENSION

Hypertension affects nearly 1/3 of Americans over the age of 20 and 3/4 of those over 65 years of age^[1]. Hypertension can be treated with pharmacological interventions, but the drug therapies are often accompanied by unwanted side effects including reduced functional capacity and orthostatic hypotension^[2]. Accordingly, non-pharmacological lifestyle modifications that can help resolve hypertension without the associated side effects of medication are increasingly emphasized. Indeed, recommendations by the Joint National Committee on Prevention,

Detection, Evaluation, and Treatment of High Blood Pressure indicate that lifestyle-based interventions can elicit hypotensive effects and should be incorporated into any treatment plan for high blood pressure^[3]. Some interventions require a lot of effort (*e.g.*, regular exercise) or drastic changes (*e.g.*, hypocaloric diet) that compliance and adherence rates may be substantially low. In this context, an idea of simply adding milk into the routine diet is attractive as it is easy and simple to implement. Does that help lower blood pressure?

Cross-sectional studies have found higher intakes of low-fat dairy are associated with lower risk of hypertension^[4]. Consuming 2 or more servings a day of low fat dairy products decreased the relative risk of incident hypertension by 11%^[5]. The results of the dietary intervention studies are consistent with the cross-sectional or observational findings. The Dietary Approaches to Stop Hypertension (DASH) diet is low in total fat, saturated fat, and sodium, but high in fruit and vegetables. In a hypertensive population, consuming the DASH diet combined with low-fat dairy products decreased blood pressure more than a diet high in fruits and vegetables alone^[6]. The hypotensive effects seen from the inclusion of low-fat dairy in the DASH diet are preserved by adding 4 servings/d of low-fat dairy without further adjustments to a typical diet^[7]. Yet this effect is not seen with the addition of a single serving of low-fat dairy^[8] suggesting that there is minimum dose required for the hypotensive effects of low fat dairy. Further, beneficial effects of dairy on retinal vascular structures offer promise for improved microcirculation and end-organ vascular health potentially achieved with chronic dairy consumption^[9,10].

Physiological mechanisms underlying the hypotensive effects of dairy are unknown but multiple mechanisms are likely involved. Increasing serum calcium through dietary intake would decrease serum 1,25-OH₂-vitamin D concentrations and decrease the calcium ion flux into cells thereby preventing the intracellular calcium-mediated vasoconstriction of smooth muscle cells in the muscularis externa of the arterial wall^[11]. In fact, the DASH diet with low-fat dairy included lowered 1,25-OH₂-vitamin D and intracellular calcium more than the DASH diet alone; the decreased intracellular calcium correlated with a fall in blood pressure^[12]. Additionally, an independent association between the isoform of vitamin D and increased blood pressure has been established further reinforcing the link between calcium, vitamin D, and blood pressure^[13].

Bovine milk is comprised of 31%-33% protein of which 80% is casein and 20% is whey. Both forms of proteins have been implicated in eliciting the hypotensive effects of dairy^[14-17]. These effects are likely due to the ACE-inhibiting properties of peptides, specifically casein and whey derived lactotripeptides, casokinins and lactokinins, respectively^[11,18]. Both require enzymatic hydrolysis to release the functional peptides, which is accomplished through the fermentation process of digestion by lactic acid-producing bacteria. Proline-

proline dipeptides, including Ile-Pro-Pro and Val-Pro-Pro, have shown to resist degradation during digestion and may be more effective at lowering blood pressure than other peptides^[11,18]. Twelve weeks of casein and whey supplementation in overweight men and women decreased blood pressure with no difference between the two forms of proteins^[19]. These hypotensive effects may require regular consumption of proteins as acute ingestion of whey and casein do not exert an effect on blood pressure^[15]. Certain milk peptides may inhibit endothelin-1 release by endothelium cells, reduce chronic vasoconstrictor tone, and exert the hypotensive effects^[20]. Interestingly, fermented strains of *Lactobacillus helveticus* (naturally high in ACE inhibitory tripeptides) have also been shown to reduce blood pressure, suggesting the bacteria responsible for fermentation may also play a role^[17,21].

Is there any benefit of consuming whole milk and full-fat dairy products? In the 1970s, the link between saturated fat intake and cardiovascular disease (CVD) was identified, but it wasn't until the early 1990s when recommendations to reduce saturated fat intake led to the emergence and popularity of low fat diets. As a result, the notion that whole milk/dairy would exert unfavorable effects on blood cholesterol and thus cardiovascular health became wide spread among the public. Recent reviews and meta-analyses on dairy and blood pressure have found no such link between full-fat dairy and CVD^[14,22]. In regards to blood pressure, while low fat dairy has consistently demonstrated hypotensive effects, full-fat dairy showed no such association^[4,23]. Interestingly, if peptides and calcium are the primary contributors to the hypotensive effects of dairy, it seems reasonable that full-fat dairy products would also elicit the hypotensive effects seen from low-fat dairy as these components are still present at similar quantities. Future dietary interventions using whole milk and full-fat dairy are needed to answer this important and relevant question.

Clearly, simply adding milk and dairy to the routine diet does not elicit unwanted side effects and is an easy lifestyle modification to make. It is much easier than performing strenuous exercise or undergoing hypocaloric diet. Obviously, this dietary intervention is not suitable for those with lactose intolerance but is highly generalizable to most individuals with high blood pressure. However, there are a lot of unanswered questions regarding the relation between dairy products and hypertension. Is whole milk and full-fat dairy effective in lowering blood pressure? What is the dominant physiological mechanisms underlying the hypotensive effects of dairy? What dairy products (*e.g.*, milk, yogurt, cheese) are most effective in reducing blood pressure? Is there any additive hypotensive effects of dairy when they were combined with other lifestyle modifications^[24]? Regardless, for those diagnosed with hypertension, adding low-fat dairy to a treatment plan of nutritional, lifestyle, and pharmacological interventions could be a small

investment that yields a lifetime of returns.

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