



Dairy intake and the risk of incidental hypertension

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Hypertension is one of the most important risk factors for cardiovascular disease, and measures for its primary prevention are urgently needed. In addition to genetic background, environmental factors may enhance the risk of hypertension. Diet is a modifiable factor and has been considered to be particularly important in preventing hypertension. In recent years, several longitudinal studies on the association between dairy intake and the development of hypertension have been reported. For example, the Women's Health Study conducted on health professional women showed that the relative risk of incident hypertension was significantly decreased with increasing amounts of low-fat dairy product intake, even after adjusting for major hypertension risk factors [1]. Similar associations have been found in studies of the community-dwelling general population, such as the Rotterdam Study and Framingham Heart Study Offspring Cohort [2, 3]. Furthermore, a recent meta-analysis including 16 studies showed that a higher consumption of various dairy products is associated with a decreased risk of developing hypertension in adults [4]. In addition, intervention studies have reported that the Dietary Approaches to Stop Hypertension (DASH) diet, which is rich in vegetables, fruits, and low-fat dairy products, is effective in achieving blood pressure reduction [5]. All of these reports suggest that increasing dairy intake may reduce the incidence of hypertension.

In this issue of *Hypertension Research*, Miyagawa et al. [6] reported the relationship between an increased frequency of dairy intake and a reduced risk of incident hypertension in a Japanese prospective cohort, providing further solid evidence supporting the beneficial effects of dairy products on the incidence of hypertension. The participants included in this study were 4,475 survivors of the

Great East Japan Earthquake in 2011. The participants were followed up by an annual health checkup for seven years, and the frequencies of the intake of dairy products (milk, yogurt, and cheese) were surveyed by a self-report questionnaire at every health checkup.

Their study showed that a more than once daily intake of dairy products was associated with a significant risk reduction of the incidence of hypertension. The analyses conducted in this study were carefully performed with consideration of the potential confounding factors associated with hypertension, including age, sex, lipid metabolism or CKD indices, lifestyle habits and the intake of fruits and vegetables. The association was still robust even in the sensitivity or stratified analyses when considering participants who were possibly less health consciousness who had undergone only one health checkup or those ≤30 years old who were less likely to be at risk of incident hypertension than older individuals.

One important limitation of this study was the lack of information on salt intake, which can significantly influence blood pressure and the incidence of hypertension. However, most dairy products consumed by the Japanese general population are milk or fermented products containing little salt, as has been mentioned [6]. Thus, it seems unlikely that adjusting the salt intake would substantially influence the main results of the study.

The overriding question is how dairy products reduce blood pressure. Previous studies have shown that an increased intake of dairy products reduces blood pressure and target-organ damage in experimental hypertension models [7–12]. Several putative mechanisms associated with the reduction in blood pressure have been reported, with three major mechanisms envisioned thus far. The first involves the effects of dairy products on the vascular system. An increase in endothelial eNOS/NO expression and restored endothelial function in spontaneously hypertensive rats (SHRs) or hypertensive rats treated with deoxycorticosterone acetate (DOCA) and fed a high-salt diet with dairy-rich foods have been demonstrated [7, 8]. In SHRs fed a diet rich in dairy products, decreased activity of

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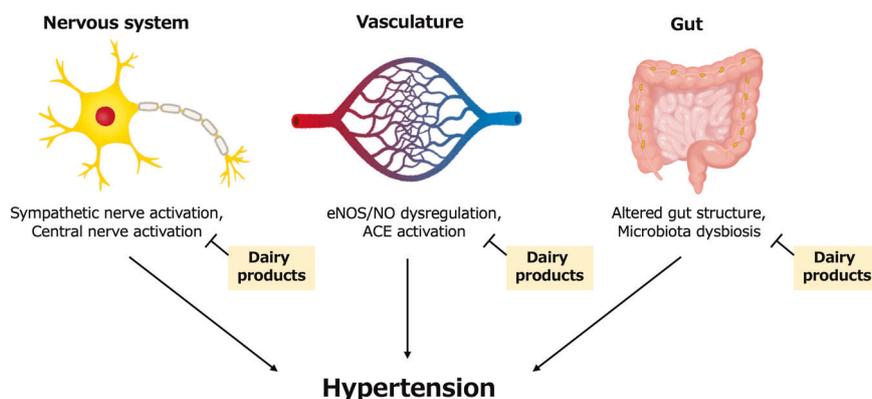


Fig. 1 Putative mechanisms involved in the antihypertensive properties of dairy products. Experimental studies have shown the putative mechanisms associated with the blood pressure-reducing effects of dairy products, which involve structural and functional changes in

multiple organs, including the nervous system, vasculature, and gut. ACE angiotensin-converting enzyme, eNOS endothelial nitric oxide synthase, NO nitric oxide

angiotensin-converting enzyme was observed, which might be another mechanism involved in the protection against hypertensive vascular injury [7, 13]. The second involves the effects on the nervous system. In the SHR model, the activated sympathetic nervous system and certain glia in the brain have been shown to be suppressed by dairy-rich foods [9, 10]. The third involves effects on the gut. An altered gut structure, microbiota dysbiosis, and activation of the cholecystokinin system, which is expressed in intestinal endocrine cells and the mesenteric artery, have been shown to be restored by an increased dietary intake of dairy products [10–12]. Taken together, these basic studies have shown that structural and functional changes in multiple organs, including the nervous system, vasculature and gut, may be involved in the blood pressure-reducing properties of dairy products (Fig. 1).

In addition, researchers have identified the bioactive components of dairy products, such as casein-derived tripeptides (isoleucine-proline-proline and valine-proline-proline) and a milk-derived pentapeptide (KFWGK), with potential blood pressure-reducing effects [7, 12]. Detailed research on such bioactive components derived from dairy products will help clarify precisely how dairy products reduce blood pressure.

Blood pressure increases in subjects involved in disasters but returns to the predisaster value within four weeks, a phenomenon termed “disaster hypertension” [14]. Since the study by Miyagawa et al. excluded this subgroup of participants from the analysis, those with disaster hypertension were not included in their study. One strength of their study is that they analyzed the risk of incident hypertension among survivors during the seven years following a severe natural disaster. It is noteworthy that this study may add knowledge regarding the benefits of dietary components that can aid survivors of severe natural disasters, a population known to be at an increased risk of several diseases

compared to the general population [15]. For such survivors, being “restricted” in dietary intake might be difficult after a serious disaster. However, information regarding what kinds of foods are recommended to avoid diseases would be welcome and give some hope to survivors despite their dire situation.

The results of the study by Miyagawa et al. are good news that support the health benefits for people at risk of certain types of hypertension, such as those in a stressful environment following a natural disaster. Nevertheless, it should be noted that the results may not be widely applicable to all subjects at risk of hypertension. Dairy products contain high amounts of protein, potassium, and phosphorus. Patients with advanced chronic kidney disease, for example, may be required to limit these nutrients and should therefore follow their doctor’s instructions with respect to dairy intake.

For the proper dissemination of the knowledge gathered by Miyagawa et al., further studies will be required to clarify the exact mechanisms involved in the antihypertensive effects of dairy products.

Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

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