Brief Review

Prevention of Hypertension and Cardiovascular Diseases
A Comparison of Lifestyle Factors in Westerners and East Asians

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A ppropriate lifestyle modifications are a fundamental step to prevent hypertension, which is the strongest risk factor for cardiovascular disease (CVD).1,2 However, the slope of the association between blood pressure (BP) and stroke is steeper among Asians than Westerners.3,4 This result is partly explained by the higher proportion of strokes that are hemorrhagic in Asian compared with Western populations and the steeper association of BP with hemorrhagic stroke as compared with ischemic stroke.5 The population-attributable fractions of hypertension for ischemic stroke in men and women have been reported as 40% and 36% in China, 34% and 35% in South Korea, 37% and 39% in Japan (East Asian), 15% and 44% in Australia, and 18% and 43% in New Zealand (Western), respectively.6 These differences between Westerners and East Asians depend on both genetic (racial) and lifestyle factors.

A schema of the progression from lifestyle behaviors to the onset of stroke and coronary heart disease (CHD) is shown in the Figure. Lifestyle (modifiable) and genetic (unmodifiable) factors are key cardiovascular risk factors, especially higher BP (the primary stage of CVD prevention). Furthermore, cardiovascular risk factors, especially hypertension, are key factors for the prevention of CVD (the secondary stage of CVD prevention). To prevent CVD, it is important to improve lifestyle and reduce cardiovascular risk factors in the early stage.

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The guidelines put out by the United States,7 Europe,8 China,9 and Japan10 for lifestyle modifications for prevention of hypertension are similar, namely: (1) salt restriction, (2) high consumption of vegetables and fruits, (3) increased intake of fish and reduced content of saturated/total fat, (4) appropriate weight control, (5) regular physical exercise, (6) moderate alcohol consumption, and (7) quitting smoking. These factors are also considered as important stroke-prevention guidelines.11,12

In this review, I compare finding from studies on lifestyle status in Westerners and East Asians in relation to these basic hypertension guidelines (Table).

Salt Restriction

Many epidemiological studies have shown that reduced salt intake is directly related to decreased BP.13-15 The Dietary Approaches to Stop Hypertension (DASH) diet, which was a randomized trial comparing the effects on BP of 3 total salt intake levels (8.3, 6.2, and 3.8 g/d for high, intermediate, and low salt intakes), showed significantly lower systolic (SBP, −5.9, −5.0, and −2.2 mm Hg) and diastolic BPs (DBP, −2.9, −2.5, and −1.0 mm Hg) at each salt level, respectively.14 The DASH diet and salt reduction independently lowered SBP and DBP.

In a Chinese study that included a 7-day low-salt intervention (51.3 mmol/d), a 7-day high-salt intervention (307.8 mmol/d), and a 7-day high-salt plus potassium supplementation (60 mmol/d), the correlation coefficients of the SBP responses to low-sodium and high-sodium intervention were −0.47 and that to high-sodium intervention and potassium supplementation was −0.52.16 These correlation coefficients were greater than those reported by the DASH-Sodium trial.17

The Intersalt Study13 and the INTERMAP (International Study of Macro-/Micronutrients and Blood Pressure) Study18 reported medium values of urinary salt excretion of 5.9 to 8.0 and 8.3 to 10.7 g/d in the United States, 8.8 and 7.5 to 9.4 g/d in the United Kingdom, 11.5 to 14.2 and 14.6 to 17.2 g/d in China, 9.2 and 7.5 to 8.8 g/d in Southern China, and 10.2 to 11.8 and 10.9 to 12.3 g/d in Japan, respectively. Salt intake by East Asians is higher than that by Westerners. This tendency was more remarkable 50 years ago. Dahl19 showed a positive linear relationship between the prevalence of hypertension and mean salt intake across 5 population groups in the 1950s: 4 g/d among Alaskan Eskimos, 7 g/d in Marshall Islanders (Pacific Ocean), 10 g/d in the United States (Brookhaven), 14 g/d in Hiroshima (South Japan), and 27 g/d in Akita (Northeast Japan). Dahl19 also noted a strong north-south trend in death rates of stroke in Japan.

The salt intake of North Japan is among the highest in East Asia. This extremely high sodium intake is attributable to higher consumption of tsukemono (Japanese pickles), soy sauce (seasoning), and miso soup. Higher carbohydrate intake (rice) and lower saturated fat and animal protein intakes (meat) are also observed in North Japan. These dietary patterns do not maintain adequate arterial walls and may lead to intracerebral hemorrhage.20

Asians are likely to have a genetically high salt sensitivity.21,22 The Gly460Trp variant of the α-adducin gene has been associated with renal sodium retention and salt-sensitive hypertension through enhancement of the activity of the
A meta-analysis showed a statistically significant association between salt sensitivity and \(\alpha\)-adducin Gly460Trp polymorphism in Asians (odds ratio, 1.33; 95% confidence intervals [CIs], 1.06–1.69), but not in whites, indicating that the BP response to sodium varies among ethnic groups. The frequencies of a common variant at codon 235 of the angiotensinogen gene with methionine-to-threonine amino acid substitution, the T235 allele of M235T, were 81% in Japanese and 42% in whites. The frequencies of the T(-344) allele of the T(-344)C polymorphism of the aldosterone synthase gene were 69% in Japanese and 53% in whites. The frequencies of the T825 allele of the C825T polymorphism for the G-protein \(\beta_3\) subunit were 52% in Japanese and 25% in whites.

### High Consumption of Vegetables and Fruits

Dietary fiber, potassium, magnesium, and antioxidant vitamins are abundant in vegetables and fruits. In the Health Professionals Follow-Up Study, dietary fiber, potassium, and magnesium were inversely related to baseline SBP and DBP and to changes in BP during a 4-year follow-up among US men. For men with a fiber intake of <12 g/d, the hazard ratio of hypertension was 1.57 (95% CIs, 1.20–2.05) compared with a fiber intake of >24 g/d. Fruit fiber but not vegetable or cereal fiber was inversely associated with incidence of hypertension. On the contrary, the Nurses’ Health Study has shown an inverse association between intakes of fruits and vegetables and SBP and DBP among 41,541 white US female nurses without diagnosed hypertension, cancer, or CVD. Meanwhile, the Chicago Western Electric Study demonstrated that vegetable protein, total carbohydrate, \(\beta\)-carotene, and an antioxidant vitamin score based on vitamin C and \(\beta\)-carotene were inversely and significantly related to average annual change of SBP in men for an 8-year follow-up period. During 7 years of follow-up, compared with the <0.5 cups/d group, the annual changes of SBP were −0.40 and −0.32 mm Hg for 0.5 to 1.5 cups/d of vegetables and fruits in men. Therefore, diets higher in fruits and vegetables may reduce the risk of developing hypertension.

The Ohasama study has shown that higher intake of fruit is associated with a lower risk of future home hypertension. During a 4-year follow-up, the highest quartile of fruit intake was associated with a significantly lower risk of future home hypertension.

### Table. Comparison Between Western and East Asian Studies According to the Lifestyle in the Hypertension Guidelines

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ALDH indicates aldehyde dehydrogenase; BP, blood pressure; CVD, cardiovascular disease; DASH, Dietary Approaches to Stop Hypertension; HT, hypertension; and PUFA, polyunsaturated fatty acid.

*Appeared in 2013 European Society of Hypertension/European Society of Cardiology Guidelines.
†Appeared in Seventh report of the Joint National Committee.
< indicates less than; >, greater than; <<<, much less than; and >>>, much greater than.
hypertension (odds ratio, 0.40; 95% CIs, 0.22–0.74). However, there was no association between higher vegetable intake and future home hypertension. The Shibata study demonstrated that serum vitamin C concentration was inversely associated not only with SBP and DBP, but also with incident stroke (P for trend=0.017).38 These studies suggest that a plant-based dietary pattern including fruits and vegetables benefits BP control in both Western and East Asian countries.

**Increased Intake of Fish, Reduced Content of Saturated/Total Fat, and Other Types of Diet**

Epidemiological studies show that dietary n-3 polyunsaturated fatty acids (PUFAs) and fish oil had a weak but significantly inverse association with BP.36,37 Even a small amount of fish intake (30–60 g/d) reduces the risk of CHD and sudden cardiac death in Western countries.38 In a large cohort study, a high consumption of fish (180 g/d) was associated with an 40% reduced risk of CHD, compared with low fish consumption (<23 g/d).39 This means that higher intake of fish can further reduce the risk of initial CHD events. The WHO-CARDIAC (WHO Cardiovascular Diseases and Alimentary Comparison) Study revealed an inverse relationship between the age-adjusted CHD mortality rate and the plasma levels of n-3 PUFAs worldwide.40 East Asians had lower averages of saturated fatty acid than Westerners.15 Mean dietary n-3 PUFAs in Japan is higher than those in Western countries and China.15 Japanese have among the highest n-3 PUFAs intake and one of the lowest CHD mortalities worldwide. However, Japanese have higher salt intake and higher BP, counterbalancing their high fish intake.

As another significant characteristic of Japanese food, many studies on soy intake have reported that a higher dietary intake of soy reduced the risks of cardiovascular risk factors, notably on intermediate end points such as hyperlipidemia.41 Higher soy and isoflavone intakes were associated with reduced risks of ischemic stroke and CHD in Japanese women. The risk reduction was accentuated for postmenopausal women.42 The WHO-CARDIAC Study showed an inverse relationship between age-adjusted CHD mortality rate and 24-hour urinary isoflavone excretion in men worldwide. Japan and Taipei have the highest soy intakes and some of the lowest CHD mortalities in men worldwide.40 Both the higher fish intake and high soy intake among Japanese may contribute to its status as the country with the lowest CHD mortality worldwide. However, the evidence of association between soy and BP has been limited.43

The Mediterranean diet, with its higher contents of fruits, vegetables, legumes, nuts, cereals, fish, and olive oil, has been shown to be associated with a moderate, but significant, reduction of 3.1/1.9 mm Hg in SBP/DBP during a median 4.2-year follow-up.44 These results are consistent with those of the DASH study.45

**Appropriate Weight Control**

Obesity and overweight have been rapidly increasing throughout the world in recent decades. The mean body mass index (BMI) levels (kilograms per meter squared) in men and women from East Asia (23.7 and 23.2 in Japan and 22.4 and 23.9 in China) are generally much lower than those of Westerners (27.7 and 27.2 in the United Kingdom and 29.1 and 28.7 in the United States).45 Obesity and overweight are established risk factors for CVD, hypertension, dyslipidemia, diabetes mellitus, and metabolic syndrome.46 The Framingham Heart Study showed that hypertension is approximately twice more prevalent in obese individuals than in nonobese individuals.46 The study demonstrated that the highest quintile of the BMI group exhibited 16/9 mm Hg higher SBP/DBP than those in the lowest quintile (increase in 4 mm Hg SBP per 4.5 kg increased weight).47 A meta-analysis of 25 studies has estimated that BP reductions were ~1.05 mm Hg systolic and ~0.92 mm Hg diastolic when expressed per kilogram of weight loss.48

In Japanese male office workers, BMI was shown to be a strong risk factor for incidence of hypertension in a 4-year follow-up.49 Compared with BMI <18.5 kg/m², the hazard ratios of hypertension were 2.0, 2.3, and 2.3 for BMIs of 22.0 to 24.9, 25.0 to 25.9, and ≥30 kg/m², respectively. Weight gains (≥2 kg) increased the risk of hypertension by 1.2 times.

**Regular Physical Exercise**

Many prospective cohort studies have demonstrated that physical inactivity is associated with an increasing risk of hypertension,50–52 metabolic syndrome, diabetes mellitus,53 CHD,54 stroke,51,54,55 cancer,56 and all-cause mortality.54,56 In a longitudinal study during 4-year follow-up in 1970, the relative risk for hypertension among the low-fitness group (72% of the group) was 1.5 times that of the high-fitness group.57 Subjects who moved from the low-fitness to the high-fitness group during the follow-up period had approximately half the risk of developing hypertension compared with those whose fitness levels remained low.57 In another study, normotensive subjects conducted cardiorespiratory fitness at the baseline, and each maximal metabolic equivalent unit was associated with a 19% lower risk (95% CIs, 12%–24%) during an 8.7-year follow-up period.58

In the Shibata study, heavy physical activity was a risk factor for incidence of stroke (hazard ratio, 3.3; 95% CIs, 1.2–9.5) during 1977 to 1992.59 In the 1970s, most residents engaged in agricultural work, usually by hand, and had no exercise or sports. Although mechanization has gradually reduced their amount of physical labor, they still work much harder than urban or sedentary populations. In the Osaka Health Survey, in 59784 person-years of follow-up, durations of subjects’ walk to work of 11 to 20 and ≥21 minutes were associated with 0.88 and 0.71 times reduced risk of progressive hypertension (P for trend=0.02).52

In a meta-analytic study, the studies reviewed demonstrated a robust protective effect of active commuting on cardiovascular outcomes (hazard ratio, 0.89; 95% CIs, 0.81–0.98).51 In another meta-analysis study using pedometers, 8 randomized controlled trials showed that pedometer users significantly increased their physical activity by 2491 steps/d more than controls.50 Participants in this intervention significantly decreased their SBP by 3.8 mm Hg.

**Moderate Alcohol Consumption**

Alcohol consumption is higher in Japanese men (ethanol, 26.7 g/d) than in men in the United States (10.1 g/d) and United
Kingdom. (16.6 g/d). However, for women, consumption in Westerners is higher than in East Asians.\(^6\) Nearly 50% of Koreans, Chinese, and Japanese are found to be aldehyde dehydrogenase (ALDH) deficient, the most frequent manifestation of which is called the Oriental flushing syndrome. ALDH deficiency is a risk factor for increased BP,\(^6\) as is excessive drinking.\(^6\) The high alcohol intake and high rate of ALDH deficiency among Japanese men may contribute to their elevated BP.

In a systematic review, an overall odds ratio for hypertension in 2*2 homozygotes of ALDH2 was 2.4 times higher than in wild-type homozygotes (\(^*1*\)\(^*1\)).\(^6\) This has turned out to be the case with a locus associated with BP-related traits that has recently been identified near the ALDH2 gene at 12q24.13 in East Asians. Eight common single-nucleotide polymorphisms seem to identify a common ancestral haplotype (H3). Haplotype H4 is common in East Asians (frequency, 38%) but is absent in Europeans and is rare in Africans (4%).\(^6\) Haplotype H5 is common in East Asians (29%) but is absent in Europeans and Africans. Haplotype H7 is common in Europeans (36%) but is absent in East Asians and Africans.

### Quitting Smoking

Both normotensive and untreated hypertensive smokers present higher daily BP levels than nonsmokers.\(^6\) Epidemiological data have shown that the smoking rates in East Asian men remain high at 40% to 60%, although this is after declining substantially for the past 20 years. The smoking rates were lower in East Asian women at 3% to 15% compared with Western women.\(^6\) Another epidemiological study demonstrated that the prevalences of smoking in men were higher in East Asian (68% in South Korea, 63% in China, and 47% in Japan) region than in the Western Pacific region (16% in Australia and 26% in New Zealand).\(^6\) The population-attributable fractions of CHD caused by smoking men and women were higher in the East Asian region (29% and 23% in South Korea, 27% and 22% in China, and 22% and 17% in Japan, respectively) than in the Western Pacific region (10% and 8% in Australia and 13% and 10% in New Zealand, respectively). Australia and New Zealand, with predominantly white populations, had relatively low smoking prevalences and therefore low population-attributable fractions for CVD. In a Japanese cohort study, the population-attributable fraction for CVD among men without metabolic syndrome who smoke (21.8%) was approximately the same as that among men with metabolic syndrome (19.4%).\(^6\)

### Conclusions and Perspectives

Appropriate lifestyle modifications are the first step of preventive hypertension. Official recommendations regarding lifestyle changes to improve hypertension are similar in East Asian and Western countries. However, the contributions of BP to stroke are different for Westerners and East Asians, attributable to differences in genetics and lifestyle. High consumption of fruits and vegetables, regular physical exercise, and maintaining appropriate body weight are all beneficial for BP control in both Western and East Asian populations. Fish and n-3 PUFA have a weak but significantly inverse association with BP. East Asians have the benefit of diets higher in fruits and vegetables and fish and less incidence of obesity. On the contrary, East Asians have a genetically higher salt sensitivity and a greater salt intake than Westerners. Excessive alcohol intake contributes to the increased BP in Japanese men, especially given their high rate of ALDH deficiency. The smoking rates in East Asian men are also higher than that in Western countries. To maintain an appropriate BP, East Asians should pay particular attention to quitting smoking and reducing salt and alcohol intake, whereas Westerners need to pay attention to weight control including regular exercise and consider replacing dietary meat high in saturated fat with fish. Further comprehensive prospective studies are anticipated to show how each factor contributes to BP control and a reduced risk of CVD in Westerners and East Asians.

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### Disclosures

None.

### References

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