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Dietary Risk Factors for Hypertension among Korean Adult Men

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ABSTRACT

There have been many studies indicating increased salt intake is related to elevated blood pressure (BP). Hypertension and pre-hypertension are prevalent in Korea. A national survey showed that the Korean average daily salt consumption was 12.5g, which is more than twice the current recommendation in the UK or USA. This study was performed to understand which aspects of the Korean diet contributed to high salt intake and elevated BP in Korea. The subjects consisted of 1,110 Korean adult men aged 30 to 49 years who were selected from the data of 2001 Korean National Health and Nutrition Survey, a nationwide cross sectional survey. The relationship of BP with sodium and high sodium food intakes were analyzed. After categorizing subjects according to their BP, the socio-demographic information and food and nutrients intakes were analyzed. BP increased with a larger amounts of sodium intake and the trend was significant with diastolic BP. However, the trends of BP for sodium densities of the diet were not. People with hypertension significantly tended to be older, larger, and less educated than people with normal BP. And they consumed more foods from the fats, oils & sweets group and larger amounts of discretionary sodium than normal people. The current report advocates that public health intervention, which improves the awareness of the role of salt on elevated blood pressure for the public, should be implemented in Korea. (*J Community Nutrition* 8(4): 193~199, 2006)

KEY WORDS: diastolic/systolic blood pressure · salt/sodium intake · Korean adult men · 2001 Korean National Health and Nutrition Survey.

Introduction

Hypertension affects more than 7 million people which is approximately 15% of the total population in Korea and places them at higher risk for death related to cardiovascular disease (CVD) (Jung 2005). In fact CVD was the third cause of death in Korea in 2004 and hypertension itself contributes to 10.7 deaths per 10 million which is almost 2.5 times higher than those of Japan, according to the National Statistical Office (Korean NSO 2004).

More than average 12g of daily salt consumption is likely to be one of major risk factors for Koreans to be exposed to have higher blood pressure than any other people in the world. Sodium itself is an essential electrolyte to the human body; however, MacGregor and Sever have insisted there is overwhelming evidence that high salt intake is a risk factor for blood pressure regulation while controversy has been made on the effect of salt restriction on lowering blood pressure over many years (MacGregor, Sever 1996). According to the report of the World Health Organization (WHO)/Food and Agriculture Organization (FAO) expert consultation, high sodium intake is 'convincingly' associated with CVD (Joint WHO/FAO expert consultation 2002). Also Ezzati et al. (2002) notes, "High blood pressure; which is one of the leading causes of global burden, is the most important risk factor for CVD" and the recent WHO report supports that elevated blood pressure, known as hypertension alone, causes around 50% of CVD worldwide (WHO 2004). Therefore salt intake, hypertension and CVD are likely to be closely interrelated with each other. Understanding the effect of dietary composition, or behaviors on blood pressure, is therefore important for the public health interest and especially for the middle-aged men whose age group has the highest prevalence of hypertension among Koreans whilst the people in

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the group are the most active labor force for the economy.

This report has explored the relationship between dietary characteristics and elevated blood pressure among Korean men, using data extracted from the 2001 Korean National Health and Nutrition Survey (NHNS). Findings from this study could suggest more relevant information for Koreans for their own diet related to the high prev-alence of hypertension than the studies from abroad whose diets are quite different from those of Koreans.

Subjects and Methods

1. Subjects and Examinations

Data from the 2001 Korean NHNS were used, which was a cross-sectional and stratified multiage probability design. The survey subjects completed questionnaires for socio-demographic information and took health examinations includeing BP and anthropometric measurements. Also, a detailed 24-hour recall method was applied to assess the amount of certain food intake for a day through an individual interview. More information of the survey is described in detail elsewhere (Korean MOHW 2002). For the current study, a total of 1,110 men aged 30 to 49 years who had both health examination records and dietary records were selected. The differences in blood pressure were analyzed according to the quartile of sodium intakes and selected dish intake for the total subjects; however, to compare selected characteristics between hypertensives and normotensives, according to their levels of systolic and diastolic blood pressure (SBP and DBP), subjects were divided into hypertension (SBP > 140 mmHg or DBP > 90mmHg), pre-hypertension (120 − 139 mmHg for SBP or 80 − 89mmHg for DBP), and normal (SBP < 120mmHg and DBP < 80mmHg) (NHLBI 2003). Overall characteristics of all subjects are described in Table 1.

2. Dietary assessments

We assessed the subject's daily nutritional status through energy intake and its percent proportion from each macronutrient (%E), crude intakes and densities (amounts per 1,000 kcal) of micronutrients, and food intakes from major food groups. Also, we compared nutritional status and salty dish consumption between normal and hypertensive subjects.

Sodium intakes were analyzed in various ways; crude, per 100g of food intakes, per 1,000kcal energy intakes. To describe the 20 biggest contributors for the daily sodium per person, 8 dish groups were chosen among 29 dish groups categorized in the Korean NHNS dataset. In this analysis, the rice group, which contributes to approximately 16.2% of the daily sodium intake for both hypertensives and normotensives (data not shown), was excluded since most Koreans eat more than 3 portions from the rice group everyday and

Table 1. Baseline characteristics of the participants

	All participants (n = 1110)	Hypertension (n = 251)	Pre-hypertension (n = 478)	Normal (n = 381)	$p^{2)}$
Age (yr)	39.2 ± 5.5[1)]	40.7 ± 5.6	38.7 ± 5.5	38.7 ± 5.3	< .0001
BMI (kg/m^2)	24.0 ± 3.0	25.0 ± 3.0	24.3 ± 2.9	23.0 ± 2.8	< .0001
Blood pressure (mmHg)					
Systolic	122.5 ± 14.6	140.5 ± 14.2	123.5 ± 7.0	109.5 ± 6.5	< .0001
Diastolic	80.6 ± 10.7	95.0 ± 7.5	80.8 ± 5.1	70.9 ± 5.8	< .0001
Treatment of hypertension [n (%)]	29 (2.6)	18 (1.6)	11 (0.99)	0 (0.00)	
Monthly income (%)					0.63
< $1500	22.3	27.1	21.1	20.7	
$1500 − $3000	21.1	17.5	22.8	21.5	
$2000 − $3000	30.3	29.9	29.5	31.8	
> $3000	26.1	25.5	26.6	26.0	
Current smokers [n (%)]	682 (61.5)	151 (13.6)	304 (27.4)	227 (20.5)	0.43
Alcohol intake (g/day)	38.2 ± 34.3	35.7 ± 28.1	41.0 ± 40.0	35.8 ± 29.2	0.38
Educational level (%)					0.099
High-school graduate	11.1	13.2	10.3	10.8	
College graduate	43.6	49.0	43.7	39.9	
University graduate	41.1	33.1	41.8	45.7	

[1)] mean ± SD.

[2)] P-values for differences in characteristics among hypertension, pre-hypertension and normal subjects were given by ANOVA.

relative sodium intake is not significantly large considering the amount of total intake.

3. Statistical analyses

Data are presented as mean ± standard deviation (SD) unless otherwise stated. For comparing differences in continuous variables, t-tests and one-way ANOVA were used where appropriate. All data were analyzed by using SAS version 9.1 (SAS Institute Inc, Cary, NC, USA). Statistical significance was set at $\alpha = 0.05$ for all analyses.

Results

1. Overall blood pressure differences over various dietary factors

As shown in Table 2, there was a significant trend of increasing mean DBP with increasing quartile of total sodium intakes ($p = 0.042$). Mean SBP increased with a larger amount of sodium intakes but the trend was not statistically significant ($p = 0.14$). When amounts of food intakes and energy intakes were considered together with sodium intakes, although the trend of increasing blood pressure with larger amounts of sodium intake was consistent, the trend was not statistically significant.

The differences in blood pressure with various dietary factors were further explored with comparison of the blood pressure of subjects who consumed certain salty foods and those who did not (data not shown). For the selected dish group, mean SBP and DBP were significantly higher in subjects who reported to eat from the noodle and dimsum group ($p < 0.0001$ for SBP and DBP) and the pickled vegetable group ($p = 0.0006$/$p = 0.0019$, SBP/DBP respectively) than subjects who did not. Especially, people who ate ramyeon, which is the most frequently consumed instant noodle in Korea, were significantly higher in DBP ($p = 0.034$).

2. Differences between hypertensive and normal subjects in dietary factors

As shown in Table 1, physical records and the basic nutrient variables including macro- and micro- nutrients were analyzed and they were compared by t-test. Hypertensive subjects were approximately 2 years older ($p < 0.0001$) and had approximately 2kg/m^2 larger BMI than those of the normotensive group ($p<0.0001$). There was a larger proportion of university graduates among normal subjects and overall ed-ucation level was higher in normotensives than that of hypertensives ($p = 0.034$). Mean alcohol intake did not differ significantly.

The selected dietary characteristics of the hypertensives and normotensives were summarized in Table 3. It showed that hypertensive people consumed more protein and fat as well as energy but less micronutrients comparable to the energy intake apart from Vitamin A intake. However, most differences in the nutritional density were not statistically significant between hypertensives and normal subjects. The consumption of the fats and oils group was significantly higher in hypertensive subjects compared with the normo-

Table 2. Blood pressure changes by categories of sodium intakes

Quartiles (n = 1110)	SBP (mmHg)	$p^{2)}$	DBP (mmHg)	$p^{2)}$
Quartile of sodium intakes (Na), mg				
Na < 4240	121.2 ± 15.0[1)]	0.14	79.4 ± 10.7	0.042
4240 ≤ Na < 715	122.4 ± 12.3		80.9 ± 9.5	
5715 ≤ Na < 7688	122.4 ± 16.4		80.3 ± 11.9	
Na ≥ 7688	124.1 ± 14.3		81.9 ± 10.6	
Quartile of sodium intakes per 100g of food intakes (NaDF) mg/100g				
NaDF < 288.32	121.5 ± 13.2	0.49	79.9 ± 10.1	0.36
288.32 ≤ NaDF < 329.31	122.3 ± 15.6		80.2 ± 12.0	
329.31 ≤ NaDF < 508.39	122.7 ± 14.0		80.7 ± 10.3	
NaDF ≥ 508.39	123.4 ± 16.4		81.5 ± 11.5	
Quartile of sodium intakes per 1,000kcal of energy intakes (NaDE, mg/1,000kcal)				
NaDE < 1841.95	122.0 ± 13.6	0.79	79.8 ± 10.4	0.37
1841.95 ≤ NaDE < 2466.74	122.4 ± 14.5		81.0 ± 10.8	
2466.74 ≤ NaDE < 3195.62	122.4 ± 14.8		80.4 ± 10.4	
NaDE ≥ 3195.62	123.2 ± 15.6		81.3 ± 11.2	

[1)] mean ± SD

[2)] P-values for differences in BP among quartiles were given by ANOVA.

Table 3. Dietary characteristics between hypertensive and normotensive subjects

	Hypertension (n = 251)	Normal (n=381)	P[2]
Absolute dietary intake			
Energy (kcal)	2524 ± 942[1]	2426 ± 890	0.19
Protein (g)	96.3 ± 49.8	93.7 ± 45.9	0.50
Fat (g)	53.2 ± 42.6	49.2 ± 39.3	0.23
Carbohydrate (g)	374 ± 136	380 ± 136	0.59
Calcium (mg)	582 ± 355	610 ± 420	0.39
Phosphate (mg)	1516 ± 645	1500 ± 625	0.77
Iron (mg)	15.7 ± 8.1	16.3 ± 9.8	0.36
Sodium (mg)	6495 ± 3040	6350 ± 3427	0.58
Potassium (mg)	3605 ± 1636	3580 ± 1590	0.85
Vitamin A (R.E)	812 ± 703	803 ± 826	0.88
Vitamin B_2 (mg)	1.4 ± 0.74	1.4 ± 0.82	0.76
Vitamin C (mg)	140 ± 105	150 ± 123	0.32
Proportions of energy from macro nutrients			
Protein (% E)	16.2 ± 4.8	15.9 ± 4.2	0.49
Fat (% E)	19.3 ± 9.6	18.1 ± 9.0	0.13
Carbohydrate (% E)	64.6 ± 11.7	66.0 ± 11.1	0.13
Nutritional density			
Calcium (mg/1,000kcal)	239 ± 137	256 ± 141	0.15
Phosphate (mg/1,000kcal)	606 ± 146	624 ± 138	0.13
Iron (mg/1,000kcal)	6.3 ± 2.8	6.9 ± 3.6	0.036
Sodium (mg/1,000kcal)	2684 ± 1106	2704 ± 1192	0.84
Potassium (mg/1,000kcal)	1445 ± 407	1497 ± 395	0.12
Vitamin A R.E/1,000kcal)	334 ± 319	334 ± 254	0.97
Vitamin B_2 (mg/1,000kcal)	0.54 ± 0.19	0.57 ± 0.21	0.058
Vitamin C (mg/1,000kcal)	57.7 ± 42.0	64.0 ± 50.4	0.088
Food groups intake (g)			
Bread, Cereal, Rice & Pasta	317 ± 614	306 ± 597	0.61
Fruit & Vegetable	35.1 ± 38.3	39.1 ± 145	0.27
Meat, Poultry, Fish, Dry Beans, Eggs & Nuts	68.9 ± 215	59.5 ± 185	0.14
Milk, Yogurt & Cheese	326 ± 601	228 ± 433	0.30
Fats, Oils & Sweets (inc. soft drinks)	39.1 ± 197	26.8 ± 149	0.012

[1] mean ± SD
[2] P-values for differences between hypertension and normal were given by ANOVA.

tensives, and it differed significantly ($p = 0.012$). Even though the difference between hypertensives and normotensives was not significant, people with hypertension did consume a larger amount of foods from the cereal, meat, dairy, and fats group overall while they consumed less from the fruits and vegetable group.

Described in Table 4 are the top twenty menu names which were based on the ranking of average sodium intakes in each group. The list represents not only the amounts of sodium included, but also the frequency of the menu eaten and the amounts of the menu consumed. It gives the information of the major source of sodium intakes. As shown in Table 4, ramyeon (instant noodles), soybean paste jji-gae (stew), noodles with ja-jang sauce (black sauce paste), and kal-guk-su (noodles) were more highly ranked in the hypertensive group than in the normotensive group.

The food items which contribute to making Korean dishes generally salty were put into the analysis. These items are basic ingredients used for the Korean traditional foods which are characterized by hot and salty. Again, overall sodium intakes from all those salty food items in hypertensives were larger than normotensives but the difference was not statistically significant except for those from table salt (Fig. 1). According to the analysis, hypertensive subjects consumed

Table 4. Menu lists of 20 biggest sources of sodium intake

Rank	Hypertension (n = 251)		Normal (n = 381)	
	Menu name	Mean sodium intake[1)]	Menu name	Mean sodium intake[1)]
1	Well polished rice (Domestic rice)-Japonica type	3176	Well polished rice (domestic rice)-Japonica Type	3241
2	Korean kimchi, chinese cabbage	1430	Korean kimchi, chinese cabbage	1487
3	Rice with mixed cereals	1239	Rice with mixed cereals	1124
4	Ramyeon (Instant noodles)	344	Kimchi, small radish (Pony tail)	349
5	Coffee (including mix, instant)	299	Barley-polished grain	325
6	Rice with soybeans (dried black soy beans, heuk-tae)	239	Rice with soybeans (dried black soy beans, heuk-tae)	319
7	Kimchi, small radish (Pony tail)	239	Ra myeon (instant noodles)	298
8	Kimchi jji-gae (casserole)	234	Kimchi jji-gae (casserole)	218
9	Barley-polished grain	222	Cheong-guk-jang (fermented soy bean)	197
10	Soybean paste jji-gae (stew)	211	Kimchi, kkak-du-ki (seasoned cubed radish roots)	171
11	Noodles with ja-jang sauce (Black sauce paste)	153	Soybean paste jji-gae (stew)	165
12	Kal-gu-ksu (noodles)	138	Coffee (including mix, instant)	159
13	Dan-mu-ji (salted radish in rice bran)	128	Glutinous rice (well polished)	102
14	Mixed soybean paste with red pepper paste	126	Fried seaweed	94
15	Whole milk	120	Bean sprouts soup	91
16	Glutinous rice (well polished)	106	Grilled fish	86
17	Cheong-guk-jang (fermented soy bean)	105	Seaweed soup	85
18	Kimchi, kkak-du-ki (seasoned cubed radish roots)	94	Mixed soybean paste with red pepper paste	84
19	Glutinous millet	83	Kal-guk-su (noodles)	83
20	Raw fish with soybean sauce or soybean paste	76	Stir fried pork with red pepper paste	74

[1)] Total amount of sodium from each dish was divided by the number of subjects in each column.

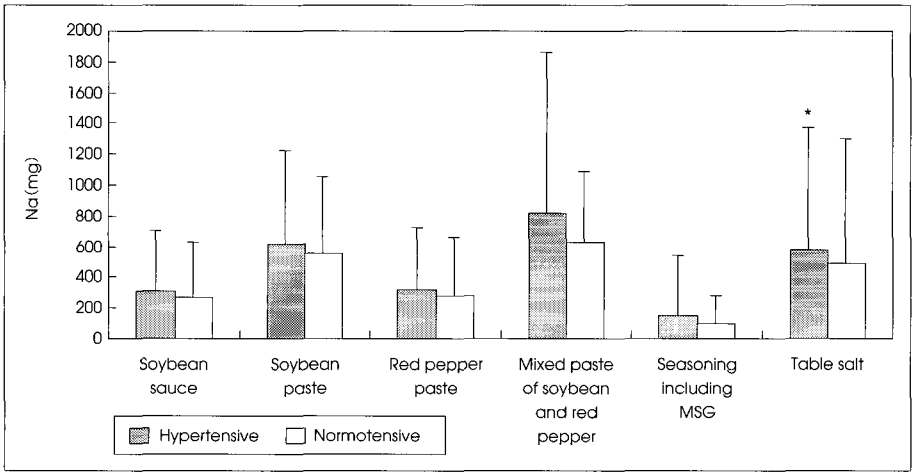

Fig. 1. Differences in sodium intakes between hypertensives and normotensives by selected salty food item. *: Mean sodium intake of hypertensives was significantly different from that of normotensives ($p < 0.05$).

more sodium from table salt during meals and the difference was statistically significant ($p = 0.0498$).

Discussion

No published reports so far have included commonly consumed salty foods among Koreans as risk factors for elevated blood pressure. Analyses of these various dietary factors helped to identify a potentially important distinction of the nutritional patterns of hypertensive subjects and normotensive subjects.

This analysis produced several key findings which are important for the prevention of hypertension in Koreans. First of all, the present analysis supports the evidence from lite-

rature that blood pressure increased with a larger amount of sodium intakes and the trend was significant with DBP. It is a distinctive aspect as compared with the previous trials which have showed the significant result mainly with SBP. When energy intakes and total amounts of food intakes were considered, increased sodium intake changed blood pressure consistently despite their non-significant trends.

Secondly, for the comparison of dietary components by hypertensive versus normotensive subjects, people with hypertension who tended to be older, larger, and less educated than people with normal blood pressure, had the nutritional pattern of high intakes of sodium from salty food items in general although the difference was not statistically significant. However, sodium intake from table salt, which reflects salt added during meals, was significantly larger in hypertensive subjects compared with normal subjects. It is therefore plausible that adding table salt during meals would be one of the risk factors for developing hypertension among Koreans.

Finally, it was observed that the hypertensive group of subjects consumed high salt containing noodles, such as ramyeon, ja-jang-myeon, and kal-guk-su, at higher frequency than the normotensive. As one of favorite snacks for Koreans, ramyeon was recommended to reduce its surprisingly high sodium content by WHO in 2005 (Korean Federation for Environmental Movement 2005). The average 2,075mg of sodium that is included in one portion of ramyeon is already 1.4 times larger than that of WHO daily sodium intake guidelines (Korean Federation for Environmental Movement 2005). The result suggests that industries should make efforts to reduce the sodium contents in ramyeon as well as instant ja-jang-myeon, kal-guk-su and the other noodles in soup.

Currently, the Food Standards Agency (FSA) in the UK has set a target of reducing the average salt consumption of adults to 6g a day by 2010 and launched a campaign of people to reduce their salt intake based on advice from the Committee on Medical Aspects of Food and Nutrition Policy (COMA) in 1994 and the report of Scientific Advisory Committee on Nutrition (SACN), Salt and Health in 2003 (Eaton 2004).

However, despite acknowledging the recommendations of reducing salt intake from COMA and SACN reports as well as the totality of evidence explored in the present paper, it should be noted the difficulty of gaining a great reduction in blood pressure by advising people to reduce their salt intake, especially in people with normal blood pressure as Cochrane reviews showed earlier (He, MacGregor 2004; Hooper et al. 2004; Jurgens, Graudal 2004). It is therefore likely to be impractical for people just to eat no more than 6g/day especially in Korea where a large amount of salt is consumed from a habitual diet. Instead, it would be more realistic to achieve the risk factor reduction by encouraging people to reduce at least 1g of salt gradually, considering the benefit would be substantial to the entire population although a higher level of target would be set than the other countries, and also by steadily adjusting levels of salt content of processed foods over time in cooperation with the food industry.

There are limitations of the present study. First, the study was not specifically powered to look at differences between hypertensives and normotensives, but to explore trends in dietary characteristics among high risk Korean men. In addition, among the 30 to 49 years old men studied, approximately 22.6% were already hypertensive and 43.1% were pre-hypertensive, i.e. high blood pressure was too prevalent to detect the significantly clear differences in subjects by blood pressure categories. Also, the dishes consumed among subjects were so much similar that the difference was often not distinguishable. Future studies should specifically be powered to look at the difference clearly.

Second, having considered the nature of the data collection method, there is likely to be considerable measurement error in the 2001 KHNS. As Bingham (1991) pointed out that the 24-hour recall method is vulnerable to both random error and systematic error and Gregory et al. (1990) found that reporting food intake underestimated salt intakes by 19% compared with the 24-hour urinary sodium. Especially, assessing sodium intake by 24-hour recall, which is extremely difficult to capture, the discretionary salt intake added during meals and cooking is probably a big matter of concern in dietary assessment (Khaw et al. 2004). In addition, the usual intakes might not be reflected by a one-day survey. Therefore, in the 2001 KHNS where a 24- hour recall was used as a primary dietary method, it is plausible that the error is substantial unless 24-hour urinary sodium, which is regarded as the most accurate sodium intake estimation, was used as the measurement error could be doubled with intra-individual variation (He, MacGregor 2005).

Also measurement error could occur in checking blood pressure since it was measured only twice within a day in the 2001 KHNS. As multiple literature have shown, blood pressure fluctuates with many variables such as room temperature,

pollutants in the environment, and even the subject's feeling (Staessen et al. 2000). As Patterson (1984) noted, "the measurement itself is a potential source of error, which may be coupled with subject, observer, the sphygmomanometer, or in the application of the technique." The magnitude of sodium effect on blood pressure is therefore probably attenuated by the large measurement error mentioned.

Third, the study considered dietary factors for developing hypertension mainly related to salt intake but did not consider the other important factors such as fruit and vegetable consumption which could affect the level of blood pressure. As the DASH sodium trial (Sacks et al. 2001) supported, elevated blood pressure could be better understood in the context of dietary patterns instead of focusing on a sole nutrient, sodium.

Summary and Conclusion

The present analysis provides the distinctive dietary behaviors in hypertensive subjects and describes the dietary risk factors for having elevated blood pressure for middle-aged Korean men. Although the result might be attenuated by the potential error discussed earlier, it did suggest that people with hypertension were likely to consume more salty foods than people with normal blood pressure. The current report advocates that public health intervention, which improves the awareness of the role of salt on elevated blood pressure for the public, should be implemented in Korea.

Already hypertension is one of the major diseases in Korea, where aging is becoming significantly accelerated and hypertension increases with aging. In order to lighten the burden of hypertension in Korea, the strategy of reducing dietary risk factors should be implemented and great attention should be paid to high salt intake in the Korean population.

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References

Bingham SA (1991): Limitations of the various methods for collecting dietary intake data. *Ann Nutr Metab* 35 (3): 117-127

Eaton L (2004): Food agency launches campaign to reduce salt intake. *BMJ* 329 (7467): 644

Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJL, and the Comparative Risk Assessment Collaborating Group (2002): Selected major risk factors and global and regional burden of disease. *Lancet* 360: 1347-1360

Gregory J, Foster K, Tyler H, Wiseman M (1990): The Dietary and Nutritional Survey of British Adults. HMSO, London

He FJ, MacGregor GA (2004): Effect of longer-term modest salt reduction on blood pressure. *Cochrane Database Syst Rev* (3): CD004937

He FJ, MacGregor GA (2005): Blood pressure--importance of salt intake. *Am J Hypertens* 18 (9 Pt 1): 1258-9; author reply 1259-1261

Hooper L, Bartlett C, Davey SG, Ebrahim S (2004): Advice to reduce dietary salt for prevention of cardiovascular disease. *Cochrane Database Syst Rev* 1: CD003656

Joint WHO/FAO expert consultation (2002): Diet, nutrition and the prevention of chronic diseases. WHO, Geneva

Jung N (2005): Killer in silence, hypertension, Weekly Chosun, www.weekly.chosun.com

Jurgens G, Graudal NA (2004): Effects of low sodium diet versus high sodium diet on blood pressure, renin, aldosterone, catecholamines, cholesterols, and triglyceride. *Cochrane Database Syst Rev* 1: CD004022

Khaw K, Welch A, Luben R, O'Brien E, Wareham N, Day N (2004): Blood pressure and urinary sodium in men and women: the Norfolk Cohort of the European Prospective Investigation into Cancer (EPIC-Norfolk). *Am J Clin Nutr* 80: 1397-1403

Korean Federation for Environmental Movement (2005): Sodium contents in instant noodle, Ra Myeon. Korean Federation for Environmental Movement, Seoul

Korean Ministry of Health and Welfare (MOHW) (2002): Korean National Health and Nutrition Survey Report. MOHW, Seoul

Korean National Statistical Office (NSO) (2004): The Korean standard classification of diseases and causes of death. National Statistical Office, Seoul

MacGregor GA, Sever PS (1996): Salt--overwhelming evidence but still no action: can a consensus be reached with the food industry? *BMJ* 312 (7041): 1287-1289

National Heart, Lung, and Blood Institute (NHLBI) (2003): Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. The seventh report of the joint national committee, NHLBI

Patterson HR (1984): Sources of error in recording the blood pressure of patients with hypertension in general practice. *Br Med J (Clin Res Ed)* 289 (6459): 1661-1664

Staessen JA, O'Brien ET, Thijs L, Fagard RH (2000): Modern approaches to blood pressure measurement. *Occup Environ Med* 57 (8): 510-520

Sacks FM, Svetkey LP, Vollmer WM (2001): Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *N Engl J Med* 344 (1): 3-10

World Health Organization (WHO) (2004): Global status report on alcohol 2004. WHO