고혈압 가족력이 고혈압 유병, 관리 및 건강 행태에 미치는 영향: 국민건강영양조사 2014−2016

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The Influence of Family History of Hypertension on Hypertension Prevalence, Management and Healthy Behaviors among Korean Adults: Results from the Korea National Health and Nutrition Examination Survey 2014-2016

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Background: This study was designed to investigate the influence of family history of hypertension (FH) on hypertension prevalence, management, and healthy behaviors among Korean adults.
Methods: By using data from the Korea National Health and Nutrition Examination Survey 2014-2016, a cross-sectional study was performed. The study population included 8,280 individuals who underwent health examination and food frequency questionnaire were divided into two groups based on FH. Participants with one or more first-degree FH classified as having a FH. Health behaviors analyzed were low sodium intake, weight management, no smoking, non-risky drinking, and sufficient physical activity. Multiple logistic regression analyses were used to compare outcome variables (hypertension prevalence, awareness, treatment, control, and healthy behaviors).
Results: Of a total of 8,280 subjects, 3,626 (43.8%) participants had FH. Presence of a FH significantly associated with the risk of hypertension prevalence (adjusted odds ratio [aOR], 2.47; 95% confidence interval [CI], 2.01-3.04), awareness (aOR, 1.97; 95% CI, 1.30-2.99), treatment (aOR, 2.61; 95% CI, 1.71-3.98), and control (aOR, 1.77; 95% CI, 1.19-2.64). In contrast, FH was not significantly associated with healthy behaviors. In the subgroup analyses, the normotensives with FH were even slightly less likely to get health check-ups than those without FH (aOR, 0.84; 95% CI, 0.72-0.99).
Conclusions: Although those with FH showed higher prevalence, awareness, treatment, and control rates, health behaviors of those with FH were not higher than those without FH. More attention should be directed to promote the healthy behaviors for management and prevention of hypertension, especially among those with FH.
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Keywords: Hypertension, Family history, Health behaviors

INTRODUCTION

Hypertension is one of many major chronic diseases affected by family history.[1] It is known that having a family history of hypertension (FH) is associated with an increase

in prevalence and incidence of hypertension.[2] Therefore, individuals with FH need to be included in the interventions for the prevention and management of hypertension. According to the 2017 American College of Cardiology (ACC)/American Heart Association (AHA) hypertension guideline, not only pharmacological approaches, but also, non-pharmacologic interventions, such as weight loss, a healthy diet (e.g., dietary approaches to stop hypertension dietary pattern), reduced intake of dietary sodium, enhanced intake of dietary potassium, physical activity and moderation in alcohol intake were suggested for prevention and treatment of hypertension.[3]

Previous studies mainly focused on the association of FH and the prevalence of hypertension.[4-7] There have also been a few studies that have investigated the association between FH and awareness, treatment and control.[8,9] However, few studies have investigated the association of FH with hypertension risk-reducing behaviors, such as healthy behaviors and health screening.

In this study, we aimed to examine recent trends in management and prevention of hypertension as well as the prevalence of hypertension based on data obtained from the Korea National Health and Nutrition Examination Survey (KNHANES) 2014-2016. We analyzed the relationship of FH with variables of two dimensions. First, the association between FH and hypertension prevalence, awareness, treatment, and control rates. Second, the relationship between FH and health behaviors such as low sodium intake, weight management, no smoking, non-risky drinking, sufficient physical activity, and getting health check-up for management, prevention, and early detection of hypertension.

METHODS

1. Study population

The KNHANES, a cross-sectional and nationwide representative survey, has been conducted by the Korean Ministry of Health and Welfare since 1998.[10] This study was based on the available results of the KNHANES 2014-2016. The survey consists of three parts: health interview, health examination, and a nutrition survey. We included 10,092 survey respondents who additionally completed the food frequency questionnaire (FFQ). FFQ were administered to adults aged 19-64. We have excluded participants with missing values for exposure variables, outcome variables and covariates. The final study population was 8,280 (male, 3,194; female, 5,086) (Figure 1).
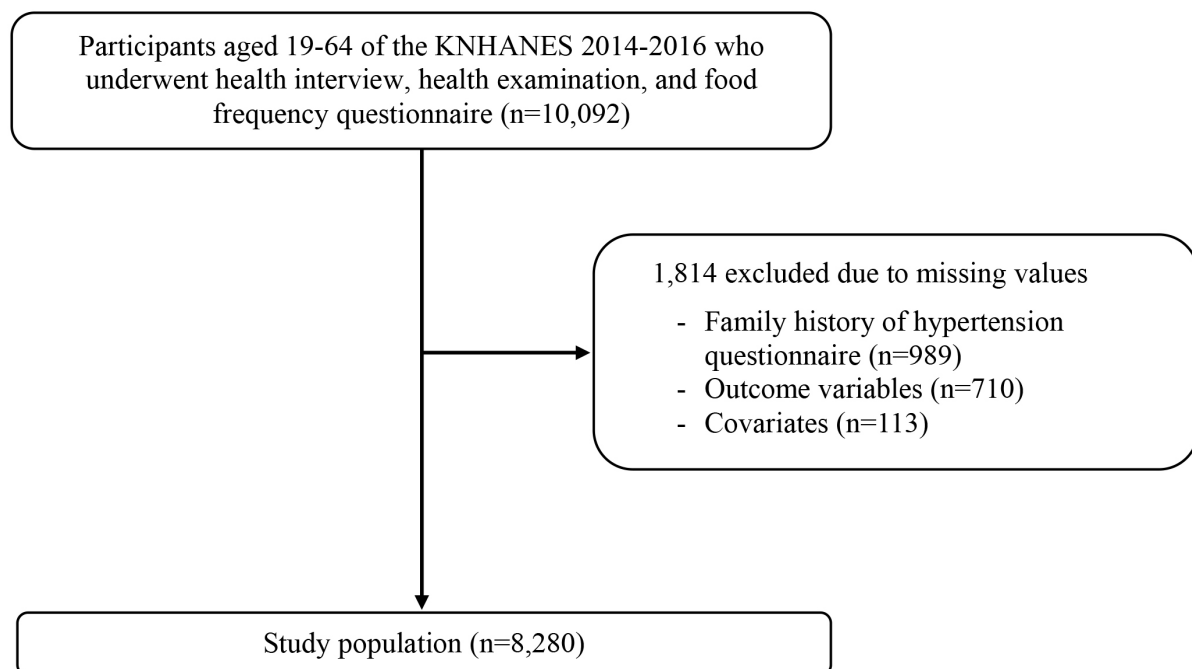

Figure 1. Flow diagram of the selection procedure for the study population.
Abbreviation: KNHANES, Korea National Health and Nutrition Examination Survey.

2. Exposure variable

The KNHANES includes a series of FH related questions, which ask participants if their mother, father or siblings have ever been diagnosed with high blood pressure. We classified individuals into two groups according to whether their first-degree relatives had hypertension. Participants with one or more first-degree FH classified as having a FH.

3. Outcome variables

With regard to hypertension prevalence, awareness, treatment and control, we used the following criteria. Prevalence of hypertension was defined as the proportion of individuals with "systolic blood pressure (SBP) ≥140 mmHg or diastolic blood pressure (DBP) ≥90 mmHg" or "currently taking anti-hypertensive medication". Hypertension awareness was defined as self-report of previous hypertension diagnosis by a doctor among the participants with hypertension. Treatment of hypertension was defined as the use of anti-hypertensive medicine more than 20 days a month among the hypertensives. Control of hypertension was defined as SBP <140 mmHg and DBP <90 mmHg among the participants with hypertension.

The survey includes questions evaluating health behaviors. In terms of diets, we defined the criteria for "low sodium intake" based on the ACC/AHA hypertension guideline.[3] From results of FFQ (based on the answers of questions on the intake frequency of 112 dietary items), the amount of sodium intake per day was calculated.[11] We divided individuals into two groups based on whether they had an intake of sodium less than 1,500 mg per day or not. The low sodium intake was defined as taking less than 1,500 mg of sodium per day. Among the overweight and obese people, they were defined as the "weight management" group when trying to lose weight. In participants with normal weight, they were defined as the "weight management" group when trying to maintain normal weight. Regarding smoking, individuals were divided into two groups, "current smoker" and "non-smoker" (non-smoker includes ex-smoker and never-smoker). Risky drinking was defined as a case of drinking more than twice a week and having an average of ≥7 drinks per occasion for male or ≥5 drinks per occasion for female. Non-risky drinking was defined as a non-alcoholic or drinking less alcohol than risky drinking. Physical activity was assessed using a global physical activity questionnaire (GPAQ).[12] According to the World Health Organization recommendations on physical activity for health, adults aged 18-64 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity. Subjects who met the criteria above were categorized into "sufficient physical activity". To assess whether participants had undergone hypertension screening, they defined whether they had received a health check-up within the last 2 years.

4. Covariates

All of the sociodemographic factors (i.e., age, sex, marital status, education level, employment status, household income, residential area, and medical insurance status), self-rated health status, and FH of chronic diseases (hyperlipidemia, ischemic heart disease, stroke, diabetes mellitus) were based on the self-administered questionnaire of the health interview survey. Body mass index (BMI) was calculated as weight in kilograms divided by height squared in meters (kg/m^2).

5. Statistical analysis

We conducted descriptive analyses (i.e., means, standard errors, numbers, and percentages) for the basic characteristics and the outcome variables. We used the Student's t-test for means or chi-square test for proportions to determine statistical differences on the variables between participants with and without FH. A P-value less than 0.05 was considered significant. In addition, we conducted logistic regression analyses and evaluated the relationship between having a FH and outcome variables, while adjusting for all the covariates. Subgroup analyses according to the morbidity of hypertension was also conducted, regarding outcomes of health behaviors and health check-up. For the estimation of proportions, adjusted odds ratios (aORs), and 95% confidence intervals (95% CIs), sampling weights were applied to represent the entire Korean adult population. We conducted all analyses using STATA/SE 14 (StataCorp, College Station, TX, USA).

Table 1. Descriptive characteristics of the study population according to the family history of hypertension[a]

	No family history (n=4,654)	Family history (n=3,626)	P
Socio-demographic factor			
Age, y	42.2±0.2	44.6±0.2	<0.001
Sex			<0.001
Male	1,934 (41.6)	1,260 (34.8)	
Female	2,720 (58.4)	2,366 (65.2)	
Marital status			<0.001
Married	3,200 (68.8)	2,751 (75.9)	
Single/divorced/separated/widowed	1,454 (31.2)	875 (24.1)	
Education level			<0.001
Middle school or lower	836 (18.0)	571 (15.8)	
High school	1,836 (39.4)	1,320 (36.4)	
College or higher	1,982 (42.6)	1,735 (47.8)	
Employment status			0.141
Non-manual	2,077 (44.6)	1,696 (46.8)	
Manual	1,001 (21.5)	739 (20.4)	
Others (students and housewives)	1,576 (33.9)	1,191 (32.8)	
Household income			0.005
Low	363 (7.8)	319 (8.8)	
Low middle	1,117 (24.0)	812 (22.4)	
Middle high	1,577 (33.9)	1,146 (31.6)	
High	1,597 (34.3)	1,349 (37.2)	
Residential area			0.798
Urban	2,163 (46.5)	1,675 (46.2)	
Rural	2,490 (53.5)	1,951 (53.8)	
Medical insurance status			0.635
National health insurance	4,544 (97.6)	3,546 (97.8)	
Medicaid	110 (2.4)	80 (2.2)	
Health status			<0.001
Body mass index, kg/m^2	23.5±0.1	23.9±0.1	
Self-rated health status			0.031
Poor/very poor	1,592 (34.2)	1,152 (31.8)	
Fair	2,383 (51.2)	1,891 (52.1)	
Excellent/good	679 (14.6)	583 (16.1)	
Family history of chronic diseases			
family history of hyperlipidemia	218 (4.7)	437 (12.1)	<0.001
family history of ischemic heart disease	247 (5.3)	373 (10.3)	<0.001
family history of stroke	321 (6.9)	642 (17.7)	<0.001
family history of diabetes mellitus	825 (17.7)	1,250 (34.5)	<0.001
Hypertension prevalence	620 (13.3)	922 (25.4)	<0.001
Healthy behaviors			
Low sodium intake	448 (8.1)	353 (8.9)	0.868
Weight management[b]	1,582 (34.7)	1,335 (37.6)	0.041
No smoking	3,760 (76.3)	3,001 (78.5)	0.021
Non-risky drinking	4,142 (87.7)	3,196 (86.0)	0.223
Sufficient physical activity	2,497 (57.4)	1,884 (54.4)	0.125
Health check-up within the last 2 years	2,908 (59.9)	2,388 (63.7)	0.002

Values are presented as estimated mean± standard error or number (estimated %), as appropriate.
P values are those of Student's t-test for means or chi-square test for proportions.
[a]At least one first-degree relatives had hypertension.
[b]The analysis excluding underweight population (n=7,905).

RESULTS

1. Characteristics of the study population

Table 1 showed the baseline characteristics of the subjects by the FH. Of the 8,280 individuals in the study population, 3,626 had a FH. The mean age of the study population was 43.3 years; 61.4% were female. The prevalence of hypertension was estimated to 25.4% in the subjects with FH and 13.3% in the subjects without FH. Regarding healthy behaviors, 8.4% of the participants reported low sodium intake. Among the individuals with a normal weight or overweight/obesity, 35.9% attempted to manage their weight to fit within the normal range. 77.2% of the participants did not smoke, 88.6% pertained to the non-risky drinking group, and 56.1% carried out sufficient physical activity. 61.5% reported to have had a health check-up within the last 2 years. In the variables of weight management, no smoking, and health check-up, there were significant differences between the subjects with FH and those without FH. In terms of the sociodemographic factors and health status, there were significant differences in age, sex, marital status, education level, household income, BMI, and self-rated health status between individuals with FH and those without. Regarding FH of chronic diseases, subjects with FH were more likely to have other family histories, such as hyperlipidemia, ischemic heart disease, stroke and diabetes mellitus.

Hypertension awareness, treatment, and control rates among the participants with hypertension according to the family history of hypertension were presented in Table 2. Among the participants with hypertension, the rates of awareness, treatment and control of hypertension were 60.1%, 56.0%, and 41.0%, respectively, in the individuals with FH, and 44.3%, 38.2%, and 28.3%, respectively, in the individuals without FH.

2. Multivariate-adjusted analyses of the relationships between FH and hypertension prevalence, management, and healthy behaviors

Tables 3, 4 showed the multivariate logistic regression analysis results and aORs and 95% CIs were reported. Table 3 showed that presence of a FH significantly was associated with the risk of hypertension prevalence (aOR, 2.47; 95% CI, 2.01-3.04), awareness (aOR, 1.97; 95% CI, 1.30-2.99), treatment (aOR, 2.61; 95% CI, 1.71-3.98), and control (aOR, 1.77; 95% CI, 1.19-2.64). According to the adjusted analyses of the all study participants, however, none of the healthy behaviors were significantly associated with having a FH (Table 4). In the subgroup analyses, having a FH was even negatively associated with getting health check-up within the last 2 years among the normotensives, after adjustment (aOR, 0.84; 95% CI, 0.72-0.99).

DISCUSSION

In this national representative population-based study of Korean adults, participants with FH showed higher prevalence, awareness, treatment, and control rates of hypertension than those without FH. However, there was no difference in healthy behaviors between those with FH and those without FH.

Our results suggest that having a FH is associated with better awareness, pharmacological treatment and control of hypertension, as well as higher prevalence of hypertension. In contrast, regarding healthy behaviors and health check-up, none of them were significantly associated with having a FH, despite the importance of non-pharmacologic interventions. The normotensives with FH were even slight-

Table 2. Hypertension awareness, treatment, and control rates among the participants with hypertension according to the family history of hypertension[a]

	No family history (n=620)	Family history (n=922)	P
Hypertension awareness	319 (44.3)	604 (60.1)	<0.001
Hypertension treatment	281 (38.2)	567 (56.0)	<0.001
Hypertension control	214 (28.3)	412 (41.0)	<0.001

Values are presented as number (estimated %).
P values are those of chi-square test for proportions.
[a]At least one first-degree relatives had hypertension.

ly less likely to take a health check-up than those without FH.

The aORs of hypertension prevalence identified in this study was in similar range with other previous studies.[2,5-7] It is known that both genetic and environmental factors of FH appear to contribute to the increase in the prevalence of hypertension.[2] There have been a few studies that have investigated associations between FH and the awareness, treatment and control of hypertension. The Control Hypertension and Other Risk Factors to Prevent Stroke with Nutrition Education in Urban Area of Northeast China (CHPSNE) study showed that the FH was associated

Table 3. Relationships between family history of hypertension[a] and the prevalence, awareness, treatment and control of hypertension

	No family history	Family history
All (n=8,280)		
Hypertension prevalence	1 (referent)	2.47 (2.01-3.04)
The hypertensives (n=1,542)		
Hypertension awareness	1 (referent)	1.97 (1.30-2.99)
Hypertension treatment	1 (referent)	2.61 (1.71-3.98)
Hypertension control	1 (referent)	1.77 (1.19-2.64)

Values are presented as adjusted odds ratio (95% confidence interval).
Adjusted for age, sex, marital status, education level, employment status, household income, residential area, medical insurance status, body mass index, self-rated health status and family history of chronic diseases.
[a]At least one first-degree relatives had hypertension.

Table 4. Stratified analysis on the relationships between family history of hypertension[a] and healthy behaviors according to subgroups of hypertension prevalence

	No family history	Family history
All		
Low sodium intake	1 (referent)	1.15 (0.90-1.46)
Weight management[b]	1 (referent)	0.98 (0.85-1.12)
No smoking	1 (referent)	0.93 (0.76-1.13)
Non-risky drinking	1 (referent)	0.79 (0.63-0.99)
Sufficient physical activity	1 (referent)	0.98 (0.85-1.13)
Health check-up within the last 2 years	1 (referent)	0.87 (0.76-1.01)
The hypertensives		
Low sodium intake (less than 1,500 mg per day)	1 (referent)	0.77 (0.47-1.27)
Weight management (try to be in normal weight)[b]	1 (referent)	0.97 (0.70-1.34)
No smoking (ex-smoker and never-smoker)	1 (referent)	1.00 (0.61-1.65)
Non-risky drinking	1 (referent)	0.82 (0.52-1.31)
Sufficient physical activity	1 (referent)	1.09 (0.77-1.55)
Health check-up within the last 2 years	1 (referent)	1.06 (0.73-1.54)
The normotensives		
Low sodium intake (less than 1,500 mg per day)	1 (referent)	1.26 (0.96-1.65)
Weight management (try to be in normal weight)[b]	1 (referent)	0.97 (0.82-1.14)
No smoking (ex-smoker and never-smoker)	1 (referent)	0.88 (0.71-1.10)
Non-risky drinking	1 (referent)	0.86 (0.66-1.12)
Sufficient physical activity	1 (referent)	0.97 (0.83-1.13)
Health check-up within the last 2 years	1 (referent)	0.84 (0.72-0.99)

Values are presented as adjusted odds ratio (95% confidence interval).
Adjusted for age, sex, marital status, education level, employment status, household income, residential area, medical insurance status, body mass index, self-rated health status and family history of chronic diseases.
[a]At least one first-degree relatives had hypertension.
[b]The analysis excluding underweight population (n=7,905).

with better awareness and treatment of hypertension.[8] In the Surinamese in the Netherlands: Study on Ethnicity and Health (SUNSET) study, FH was associated with better hypertension awareness and treatment in Dutch ethnic groups and better BP control in African ethnicity.[9] In a French study, FH was also significantly associated with cardiovascular disease risk.[13] And there were also studies showed that coronary artery disease or cardiovascular death is increased in those with FH.[14]

In the present study, we found the association of FH with better awareness, treatment and control. These findings may imply that having a FH positively influence individuals to seek medical intervention. However, there has been a little study about the association between having a FH with healthy behaviors. Our study found that there was no significant association between having a FH and most of non-pharmacologic interventions, even in subgroup analyses. Thus, having a FH might not trigger the behaviors for management and prevention in a non-pharmacological way. This result contrasted with the result of medical intervention, implying the importance of targeted interventions for populations with FH and public campaigns or education to trigger healthy behaviors and carrying out regular check-ups. This study suggests that people with FH are at high risk for hypertension and need more education about the importance of healthy behaviors.

This study has several limitations to be considered. First, the exact causality among variables were not determined because of the nature of cross-sectional study. Further studies are needed to figure out the exact relations among factors, such as the recognition of FH, the realization of such a history's risk and the lack of sufficient triggers for healthy lifestyles or health check-up. Second, because the study was based on subject self-reported survey data, respondents may have reported incorrectly, leading to possible inaccuracy. Third, FH could only be defined based on first-degree relatives, since information for other relatives was not asked. Differences in the definition of FH between studies may lead to inconsistent findings. Despite these limitations, our study has its own strength. This study is the first to investigate the association between FH with both hypertension prevalence and healthy behaviors, based on the data representative of Korean adults. Second, this study considered many potential confounders such as socio-demographic factors, health status, and family history of chronic diseases.

In this national representative population-based study of Korean adults, participants with FH showed higher prevalence, awareness, treatment, and control rates of hypertension than those without FH. However, there was no difference in healthy behaviors between those with FH and those without FH. More attention should be directed to promote the behaviors for management and prevention in a non-pharmacological way, especially among those with FH.

요   약

연구배경: 본 연구는 고혈압의 가족력이 고혈압 유병, 관리 및 건강 행태에 미치는 영향을 알아보고자 시행되었다.

방법: 국민건강영양조사 2014-2016에 참여하여 검진조사, 영양조사를 받은 8,280명의 사람을 대상으로 고혈압의 가족력을 기준으로 두 그룹으로 나누었다. 직계 가족 중 고혈압이 있는 참가자는 고혈압 가족력이 있는 군으로 분류되었다. 건강 행태는 저염식, 체중 관리, 비흡연, 비-위험 음주 및 충분한 신체 활동을 조사하였다. 다변량 로지스틱 회귀분석을 사용하여 결과변수(고혈압 유병률, 인지율, 치료율, 조절률, 건강 행태)를 비교하였고, 이 과정에서 가중치를 이용하고 교란요인들을 보정하였다.

결과: 총 8,280명 중 3,626명(43.8%)이 고혈압 가족력이 있었다. 고혈압 가족력이 있는 군은 가족력이 없는 군보다 높은 고혈압 유병률, 인지율, 치료율, 조절률을 보였다. 다변량 로지스틱 회귀분석에서도 고혈압 가족력이 있는 군은 가족력이 없는 군보다 높은 고혈압 유병률, 인지율, 치료율, 조절률과 관련이 있었다. 그러나 고혈압 가족력은 건강 행태와는 유의한 관련이 없었다. 하위 집단 분석에서 고혈압 가족력이 있으면서 정상 혈압인 군은 고혈압 가족력이 없는 사람들보다 낮은 건강검진 수검과 관련이 있었다.

결론: 고혈압 가족력이 있는 군은 가족력이 없는 군보다 고혈압 유병률, 인지율, 치료율, 조절률이 높았으나, 건강 행태는 차이가 없었다. 고혈압 가족력이 있는 사람들에게 고혈압의 관리와 예방을 위한 건강 행태를 장려하는데 더 큰 노력을 기울여야 한다.

중심 단어: 고혈압, 가족력, 건강 행태

REFERENCES

1. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, et al. Executive summary: heart disease and stroke statistics--2016 Update: a report from the American Heart Association. Circulation 2016;133(4):447-54.
2. Hajjar I, Kotchen JM, Kotchen TA. Hypertension: trends in

prevalence, incidence, and control. Annu Rev Public Health 2006;27:465-90.

3. Whelton PK, Carey RM, Aronow WS, Casey DE Jr, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines. J Am Coll Cardiol 2018;71(19):e127-248.

4. van der Sande MA, Walraven GE, Milligan PJ, Banya WA, Ceesay SM, Nyan OA, et al. Family history: an opportunity for early interventions and improved control of hypertension, obesity and diabetes. Bull World Health Organ 2001;79(4):321-8.

5. Stamler R, Stamler J, Riedlinger WF, Algera G, Roberts RH. Family (parental) history and prevalence of hypertension. Results of a nationwide screening program. JAMA 1979;241(1): 43-6.

6. Rampal L, Rampal S, Azhar MZ, Rahman AR. Prevalence, awareness, treatment and control of hypertension in Malaysia: a national study of 16,440 subjects. Public Health 2008;122(1): 11-8.

7. Ursua R, Aguilar D, Wyatt L, Tandon SD, Escondo K, Rey M, et al. Awareness, treatment and control of hypertension among Filipino immigrants. J Gen Intern Med 2014;29(3):455-62.

8. Tian S, Dong GH, Wang D, Liu MM, Lin Q, Meng XJ, et al. Factors associated with prevalence, awareness, treatment and control of hypertension in urban adults from 33 communities in China: the CHPSNE Study. Hypertens Res 2011;34(10): 1087-92.

9. Agyemang C, van Valkengoed I, Koopmans R, Stronks K. Factors associated with hypertension awareness, treatment and control among ethnic groups in Amsterdam, the Netherlands: the SUNSET study. J Hum Hypertens 2006;20(11):874-81.

10. Kweon S, Kim Y, Jang MJ, Kim Y, Kim K, Choi S, et al. Data resource profile: the Korea National Health and Nutrition Examination Survey (KNHANES). Int J Epidemiol 2014;43(1): 69-77.

11. Kim DW, Song S, Lee JE, Oh K, Shim J, Kweon S, et al. Reproducibility and validity of an FFQ developed for the Korea National Health and Nutrition Examination Survey (KNHANES). Public Health Nutr 2015;18(8):1369-77.

12. Bull FC, Maslin TS, Armstrong T. Global physical activity questionnaire (GPAQ): nine country reliability and validity study. J Phys Act Health 2009;6(6):790-804.

13. Lascaux-Lefebvre V, Ruidavets JB, Arveiler D, Amouyel P, Haas B, Cottel D, et al. Influence of parental histories of cardiovascular risk factors on risk factor clusters in the offspring. Diabetes Metab 2001;27(4 Pt 1):503-9.

14. Corvol P, Jeunemaitre X, Charru A, Soubrier F. Can the genetic factors influence the treatment of systemic hypertension? The case of the renin-angiotensin-aldosterone system. Am J Cardiol 1992;70(12):14D-20D.