*Supplementary Materials*

# Development of the Hypertension Index Model in General Adult Using the Korea National Health and Nutritional Examination Survey and the Korean Genome and Epidemiology Study

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**Table S1. References in the literature-based search for variables.**

| Variables | Journal | Author | Year of publication |
|---|---|---|---|
| Age, *years* | Hypertension and aging [1] | Buford TW | 2016 |
| Sex, *n* | Gender Differences in Epidemiology, Pathophysiology, and Treatment of Hypertension [2] | Di Giosia P. | 2018 |
| | Prevalence of hypertension in China [3] | Gao Y | 2013 |
| Ethnicity, *n* | Trends in prevalence, awareness, treatment, and control of hypertension in the United States [4] | Hajjar I | 2003 |
| Education status, *n*<br>Elementary school<br>Middle school<br>High school<br>University | Education, literacy, and health: Mediating effects on hypertension knowledge and control [5] | Pandit A.U. | 2009 |
| | Socioeconomic status and hypertension [6] | Leng B | 2015 |
| Income status, *n*<br>1st quartile<br>2nd quartile<br>3rd quartile<br>4th quartile | Socioeconomic status and hypertension [6] | Leng B | 2015 |
| Diabetes mellitus, *n* | Hypertension and diabetes mellitus : coprediction and time trajectories [7] | Tsimihodimos V | 2018 |
| Dyslipidemia, *n* | Dyslipidemia and the Risk of Developing Hypertension in a Working-Age Male Population [8] | Otsuka T | 2016 |
| Cancer, *n* | Hypertension and breast cancer risk [9] | Han H | 2017 |
| | Hypertension and risk of prostate cancer [10] | Liang Z | 2016 |
| | Blood pressure and kidney cancer risk [11] | Hidayat K | 2017 |
| Alzheimer disease, *n* | Association between blood pressure and Alzheimer disease [12] | Gabin, J.M. | 2017 |
| Parkinson disease, *n* | Association of blood pressure and hypertension with the risk of Parkinson disease [13] | Qiu C | 2011 |
| Non-alcoholic fatty liver disease, *n* | Hypertension and Nonalcoholic Fatty Liver Disease Proven by Transient Elastography [14] | Wang Y | 2016 |
| Smoking, *pack-years* | Association between smoking and blood pressure [15] | Primatesta P | 2001 |
| Alcohol consumption, *g/week* | Effects of alcohol reduction on blood pressure [16] | Xin X | 2001 |
| | Alcohol consumption and risk for hypertension in middle-aged Japanese men [17] | Nakanishi N. | 2001 |
| Exercise, *n* | Progressive resistance exercise and resting blood pressure [18] | Kelley GA | 2000 |

| | | | |
|---|---|---|---|
| | Effect of aerobic exercise on blood pressure [19] | Whelton SP | 2002 |
| Diet<br>Total energy intake, *kcal*<br>Sodium intake, *mg*<br>Potassium intake, *mg* | Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet [20]<br>Effects of diet and sodium intake on blood pressure [21]<br>Dietary approaches to prevent and treat hypertension [22] | Sacks FM<br>Vollmer WM<br>Appel L.J. | 2001<br>2001<br>2006 |
| Sleep duration, *hours* | Short sleep duration is associated with hypertension risk among adults [23] | Wang Q | 2012 |
| Menopause, *n* | The influence of menopause on blood pressure [24]<br>Menopause-related blood pressure increase and its relationship to age and body mass index [25] | Staessen J<br>Zanchetti A | 1989<br>2005 |
| Oral contraceptive, *n* | Prospective study of oral contraceptives and hypertension among women in the United States [26] | Chasan-Taber L. | 1996 |
| Body mass index, *kg/m2* | Influence of weight reduction on blood pressure [27]<br>Long-term effects of weight loss and dietary sodium reduction on incidence of hypertension [28] | Neter JE<br>He J | 2003<br>2000 |
| Waist circumference, *cm* | The relationship of waist circumference to blood pressure [29] | Siani A | 2002 |
| Systolic blood pressure, *mmHg* | Assessment of frequency of progression to hypertension in non-hypertensive participants in the Framingham Heart Study [30] | Vasan RS | 2001 |
| Diastolic blood pressure, *mmHg* | Assessment of frequency of progression to hypertension in non-hypertensive participants in the Framingham Heart Study [30]<br>High-normal blood pressure progression to hypertension in the Framingham Heart Study [31] | Vasan RS<br>Leitschuh M | 2001<br>1991 |
| White blood cell, *thousand/μL* | Relationship between white blood cell count and incident hypertension [32] | Shankar A | 2004 |
| Hemoglobin, *g/dL* | Association of hematocrit with blood pressure and hypertension [33] | EmamianM | 2017 |
| Fasting plasma glucose, *mg/dL* | The association between fasting plasma glucose and glycated hemoglobin in the prediabetes range and future development of hypertension [34] | Geva M | 2019 |
| Total cholesterol, *mg/dL* | A prospective study of plasma lipid levels and hypertension in women [35] | Sesso HD | 2005 |

| | | | |
|---|---|---|---|
| Triglyceride, *mg/dL* | Triglycerides and triglycerides to high-density lipoprotein cholesterol ratio are strong predictors of incident hypertension [36] | Tohidi M. | 2012 |
| Creatinine, *mg/dL* | A prospective study of blood pressure and serum creatinine [37] | Perneger TV | 1993 |
| Liver enzyme, *IU/L*<br>Aspartate aminotransferase<br>Alanine aminotransferase<br>Gammaglutamyl trasferase | Gamma-glutamyltransferase is a predictor of incident diabetes and hypertension [38] | Lee DH | 2003 |
| C-reactive protein, *mg/dL* | C-reactive protein and the risk of developing hypertension [39]<br>Multiple biomarkers and the risk of incident hypertension [40] | Sesso HD<br>Wang TJ | 2003<br>2007 |
| Interleukin-6, *ng/mL* | Inflammation and hypertension: the interplay of interleukin-6, dietary sodium and the renin-angiotensin system in humans [41] | Chamarthi B | 2011 |
| Aldosterone, *ng/dL* | Serum aldosterone and the incidence of hypertension in nonhypertensive persons [42] | Vasan RS | 2004 |
| Follicle-stimulating hormone, *IU/L* | Follicle-stimulating hormone, its association with cardiometabolic risk factors [43] | Wang N | 2017 |
| Estrogen, *pg/mL* | Serum estrogen metabolites and systolic blood pressure [44] | Masi CM | 2009 |
| Testosterone, *ng/dL* | Serum Testosterone Levels and Arterial Blood Pressure [45] | Fogari R | 2005 |
| Forced vital capacity, *L* | Rate of decline of forced vital capacity predicts future arterial hypertension [46] | Jacobs D.R | 2012 |
| Forced expiratory volume during 1 s, *L* | Blood pressure increase is inversely related to lung function [47] | Engstrom G | 2001 |

**Table S2. General characteristics of internal validation dataset (KNHANES 2016–18).**

| | Internal validation dataset (KNHANES 2016–18) n = 10,333 | | | | | |
|---|---|---|---|---|---|---|
| | Men | | | Women | | |
| | Non-hypertension | Hypertension | *P*-value | Non-hypertension | Hypertension | *P*-value |
| | n = 2,245 | n = 2,075 | | n = 3,576 | n = 2,437 | |
| Age, years | 57.4 ± 0.23 | 63.5 ± 0.24 | <.001 | 55.1 ± 0.17 | 66.1 ± 0.21 | <.001 |
| Income, n | | | .167 | | | .004 |
| 1st quartile | 520 (23.2) | 541 (26.1) | | 810 (22.7) | 620 (25.4) | |
| 2nd quartile | 568 (25.3) | 496 (23.9) | | 901 (25.2) | 619 (25.4) | |
| 3rd quartile | 570 (25.4) | 514 (24.8) | | 885 (24.7) | 624 (25.6) | |
| 4th quartile | 587 (26.1) | 524 (25.3) | | 980 (27.4) | 574 (23.6) | |
| Education, n | | | <.001 | | | <.001 |
| Elementary school | 376 (16.7) | 539 (26) | | 731 (20.4) | 1343 (55.1) | |
| Middle school | 261 (11.6) | 346 (16.7) | | 448 (12.5) | 335 (13.7) | |
| High school | 698 (31.1) | 626 (30.2) | | 1269 (35.5) | 506 (20.8) | |
| University | 910 (40.5) | 564 (27.2) | | 1128 (31.5) | 253 (10.4) | |
| Diabetes mellitus, n | 317 (14.1) | 591 (28.5) | <.001 | 260 (7.3) | 626 (25.7) | <.001 |
| Dyslipidemia, n | 161 (7.2) | 498 (24) | <.001 | 386 (10.8) | 812 (33.3) | <.001 |
| Cancer, n | 83 (3.7) | 92 (4.4) | .25 | 211 (5.9) | 170 (7) | .104 |
| Smoking, pack-years | 17.9 ± 0.39 | 21.4 ± 0.47 | <.001 | 0.6 ± 0.06 | 0.9 ± 0.1 | .045 |
| Alcohol consumption, g/week | 95.3 ± 3.15 | 129.7 ± 3.87 | <.001 | 19.9 ± 0.96 | 18.2 ± 1.31 | .291 |
| Total energy intake, kcal | 2254.4 ± 18.59 | 2118.3 ± 19.14 | <.001 | 1651.5 ± 10.93 | 1497.1 ± 12.65 | <.001 |
| BMI, kg/m2 | 23.8 ± 0.06 | 24.9 ± 0.07 | <.001 | 23.3 ± 0.05 | 25.1 ± 0.07 | <.001 |
| Waist circumference, cm | 85.1 ± 0.17 | 88.8 ± 0.19 | <.001 | 78.5 ± 0.14 | 84.5 ± 0.19 | <.001 |
| Systolic BP, mmHg | 116 ± 0.23 | 131.1 ± 0.36 | <.001 | 112.8 ± 0.2 | 134.7 ± 0.36 | <.001 |
| Diastolic BP, mmHg | 75.5 ± 0.17 | 79.5 ± 0.28 | <.001 | 72.7 ± 0.13 | 77.9 ± 0.23 | <.001 |
| FPG, mg/dL | 104.5 ± 0.55 | 112.6 ± 0.67 | <.001 | 97.5 ± 0.31 | 108.3 ± 0.59 | <.001 |
| Creatinine, mg/dL | 0.9 ± 0.0031 | 1 ± 0.0098 | <.001 | 0.69 ± 0.0033 | 0.71 ± 0.0061 | <.001 |
| Total cholesterol, mg/dL | 194.3 ± 0.79 | 182.5 ± 0.87 | <.001 | 201.6 ± 0.63 | 190.9 ± 0.82 | <.001 |
| Triglyceride, mg/dL | 157.1 ± | 167.8 ± | .008 | 115.6 ± | 138.9 ± | <.001 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2.72 | 2.95 | | 1.32 | 2.02 | |
| WBC, thousand/μL | 6.3 ± 0.04 | 6.7 ± 0.04 | <.001 | 5.7 ± 0.03 | 6.1 ± 0.03 | <.001 |
| Hb, g/dL | 15.1 ± 0.03 | 14.9 ± 0.03 | <.001 | 13.1 ± 0.02 | 13.2 ± 0.02 | .017 |

Continuous variables are presented as mean ± standard error, and categorical variables are presented as numbers (percentage, %).
Abbreviations: KNHANES, Korea National Health and Nutrition Examination Survey; BMI, body mass index; BP, blood pressure; FPG, fasting plasma glucose; WBC, white blood cells; Hb, hemoglobin.

**Table S3. Baseline characteristics of external validation dataset (KoGES).**

| | External validation dataset (KoGES) n =4,633 | | | | | |
|---|---|---|---|---|---|---|
| | Men | | | Women | | |
| | Non-hypertension | New-onset hypertension | *P*-value | Non-hypertension | New-onset hypertension | *P*-value |
| | n = 1,316 | n = 847 | | n = 1,615 | n = 855 | |
| Age, years | 49.4 ± 0.22 | 51.4 ± 0.3 | <.001 | 48.4 ± 0.19 | 53.5 ± 0.3 | <.001 |
| Income, n | | | <.001 | | | <.001 |
| 1st quartile | 127 (9.7) | 106 (12.5) | | 199 (12.3) | 224 (26.2) | |
| 2nd quartile | 304 (23.1) | 256 (30.2) | | 477 (29.5) | 298 (34.9) | |
| 3rd quartile | 540 (41) | 289 (34.1) | | 617 (38.2) | 227 (26.5) | |
| 4th quartile | 345 (26.2) | 196 (23.1) | | 322 (19.9) | 106 (12.4) | |
| Education, n | | | <.001 | | | <.001 |
| Elementary school | 185 (14.1) | 173 (20.4) | | 452 (28) | 411 (48.1) | |
| Middle school | 233 (17.7) | 203 (24) | | 413 (25.6) | 204 (23.9) | |
| High school | 544 (41.3) | 309 (36.5) | | 595 (36.8) | 196 (22.9) | |
| University | 354 (26.9) | 162 (19.1) | | 155 (9.6) | 44 (5.1) | |
| Diabetes mellitus, n | 81 (6.2) | 59 (7) | .51 | 48 (3) | 26 (3) | .999 |
| Dyslipidemia, n | 39 (3) | 20 (2.4) | .481 | 27 (1.7) | 11 (1.3) | .57 |
| Cancer, n | 4 (0.3) | 0 (0) | - | 40 (2.5) | 21 (2.5) | .999 |
| Smoking, pack-years | 12.2 ± 0.45 | 13.3 ± 0.57 | .156 | 0.3 ± 0.06 | 0.3 ± 0.07 | .996 |
| Alcohol consumption, g/week | 113.5 ± 5.01 | 132.1 ± 6.48 | .024 | 9.6 ± 0.84 | 7.5 ± 1.07 | .134 |
| Total energy intake, kcal | 1990.3 ± 15.21 | 2040.4 ± 24.24 | .08 | 1909.5 ± 17.28 | 1929.1 ± 26.86 | .539 |
| BMI, kg/m2 | 23.7 ± 0.08 | 24.3 ± 0.1 | <.001 | 24 ± 0.07 | 25.1 ± 0.11 | <.001 |
| Waist circumference, cm | 81.4 ± 0.2 | 83.7 ± 0.25 | <.001 | 77.7 ± 0.22 | 82.6 ± 0.32 | <.001 |
| Systolic BP, mmHg | 111 ± 0.29 | 117.9 ± 0.34 | <.001 | 107.1 ± 0.28 | 118.5 ± 0.36 | <.001 |
| Diastolic BP, mmHg | 74.7 ± 0.2 | 78.6 ± 0.23 | <.001 | 70.9 ± 0.2 | 77.3 ± 0.23 | <.001 |
| FPG, mg/dL | 89 ± 0.59 | 89 ± 0.71 | .987 | 82.7 ± 0.43 | 83.8 ± 0.56 | .139 |
| Creatinine, mg/dL | 1 ± 0.004 | 0.9 ± 0.006 | .261 | 0.7 ± 0.003 | 0.7 ± 0.004 | .415 |
| Total cholesterol, mg/dL | 192.1 ± 0.94 | 190.4 ± 1.22 | .262 | 186.2 ± 0.84 | 189.5 ± 1.16 | .021 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Triglyceride, mg/dL | 160 ± 2.72 | 176.5 ± 3.74 | <.001 | 127.7 ± 1.66 | 143.4 ± 2.61 | <.001 |
| WBC, thousand/μL | 6.7 ± 0.05 | 6.8 ± 0.06 | .176 | 6.1 ± 0.04 | 6.3 ± 0.06 | .124 |
| Hb, g/dL | 14.7 ± 0.03 | 14.7 ± 0.04 | .197 | 12.4 ± 0.03 | 12.5 ± 0.04 | .002 |

Continuous variables are presented as mean ± standard error, and categorical variables are presented as numbers (percentage, %).

Abbreviations: KoGES, Korean Genome and Epidemiology Study; BMI, body mass index; BP, blood pressure; FPG, fasting plasma glucose; WBC, white blood cells; Hb, hemoglobin

**Table S4. Baseline characteristics of external validation dataset (KoGES) by quintiles of hypertension probabilities in Korean men.**

| | Quantiles of hypertension probabilities | | | | | |
|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q5 | *P* for Trend |
| | n = 433 | n = 432 | n = 433 | n = 432 | n = 433 | |
| Range of probabilities | 0.0006 – 0.0347 | 0.0347 – 0.0882 | 0.0882 – 0.1904 | 0.1907 – 0.3619 | 0.3625 – 0.9611 | |
| Age, years | 46.2 ± 0.3 | 47.2 ± 0.31 | 49.7 ± 0.38 | 52.2 ± 0.4 | 55.8 ± 0.42 | <.001 |
| Income, n | | | | | | <.001 |
| 1st quartile | 18 (4.2) | 28 (6.5) | 47 (10.9) | 52 (12) | 88 (20.3) | |
| 2nd quartile | 70 (16.2) | 112 (25.9) | 106 (24.5) | 123 (28.5) | 149 (34.4) | |
| 3rd quartile | 223 (51.5) | 159 (36.8) | 172 (39.7) | 158 (36.6) | 117 (27) | |
| 4th quartile | 122 (28.2) | 133 (30.8) | 108 (24.9) | 99 (22.9) | 79 (18.2) | |
| Education, n | | | | | | <.001 |
| Elementary school | 38 (8.8) | 46 (10.6) | 65 (15) | 77 (17.8) | 132 (30.5) | |
| Middle school | 67 (15.5) | 85 (19.7) | 87 (20.1) | 96 (22.2) | 101 (23.3) | |
| High school | 192 (44.3) | 176 (40.7) | 186 (43) | 168 (38.9) | 131 (30.3) | |
| University | 136 (31.4) | 125 (28.9) | 95 (21.9) | 91 (21.1) | 69 (15.9) | |
| Diabetes mellitus, n | 18 (4.2) | 23 (5.3) | 30 (6.9) | 23 (5.3) | 46 (10.6) | .001 |
| Dyslipidemia, n | 4 (0.9) | 6 (1.4) | 8 (1.8) | 16 (3.7) | 25 (5.8) | <.001 |
| Cancer, n | 1 (0.2) | 432 (100) | 2 (0.5) | 1 (0.2) | 0 (0) | - |
| Smoking, pack-years | 12.9 ± 0.69 | 12.4 ± 0.72 | 12.3 ± 0.81 | 12.8 ± 0.87 | 12.8 ± 0.85 | .826 |
| Alcohol consumption, g/week | 86.4 ± 7.16 | 103.6 ± 8.1 | 129.2 ± 9.82 | 140.6 ± 10.1 | 144.1 ± 8.57 | <.001 |
| Total energy intake, kcal | 2028.3 ± 27.88 | 2053.2 ± 28.44 | 1981.2 ± 28.66 | 2014.3 ± 33.36 | 1973 ± 29.58 | .114 |
| BMI, kg/m2 | 22.9 ± 0.13 | 23.8 ± 0.13 | 23.8 ± 0.13 | 24.3 ± 0.13 | 24.7 ± 0.15 | <.001 |
| Waist circumference, cm | 79 ± 0.32 | 81.2 ± 0.33 | 82 ± 0.34 | 83.8 ± 0.33 | 85.3 ± 0.37 | <.001 |
| Systolic BP, mmHg | 100 ± 0.34 | 109.4 ± 0.26 | 113.9 ± 0.28 | 118.7 ± 0.28 | 126.5 ± 0.3 | <.001 |
| Diastolic BP, mmHg | 67.9 ± 0.3 | 73.9 ± 0.25 | 77.5 ± 0.26 | 79.8 ± 0.25 | 82.3 ± 0.23 | <.001 |
| FPG, mg/dL | 86.2 ± 1.03 | 88.1 ± 0.88 | 90.2 ± 1.11 | 89 ± 0.94 | 91.4 ± 1.09 | .001 |
| Creatinine, mg/dL | 0.94365 ± 0.00731 | 0.9338 ± 0.00784 | 0.95704 ± 0.00758 | 0.96343 ± 0.0081 | 0.96628 ± 0.00848 | .005 |
| Total cholesterol, mg/dL | 193.9 ± 1.64 | 192.7 ± 1.67 | 192.2 ± 1.69 | 192.5 ± 1.6 | 185.8 ± 1.72 | <.001 |
| Triglyceride, mg/dL | 153.2 ± 5.22 | 153.3 ± 4.72 | 159.3 ± 4.41 | 178 ± 5.1 | 188.7 ± 5.06 | <.001 |
| WBC, thousand/μL | 6.6 ± 0.09 | 6.6 ± 0.09 | 6.7 ± 0.09 | 6.8 ± 0.09 | 7 ± 0.09 | <.001 |
| Hb, g/dL | 14.8 ± 0.05 | 14.7 ± 0.05 | 14.7 ± 0.05 | 14.7 ± 0.05 | 14.7 ± 0.05 | .14 |

Continuous variables are presented as median ± standard error, and categorical variables are presented as numbers (percentage, %).

Abbreviations: KoGES, Korean Genome and Epidemiology Study; Q, quintile; BMI, body mass index; BP, blood pressure; FPG, fasting plasma glucose; WBC, white blood cells; Hb, hemoglobin.

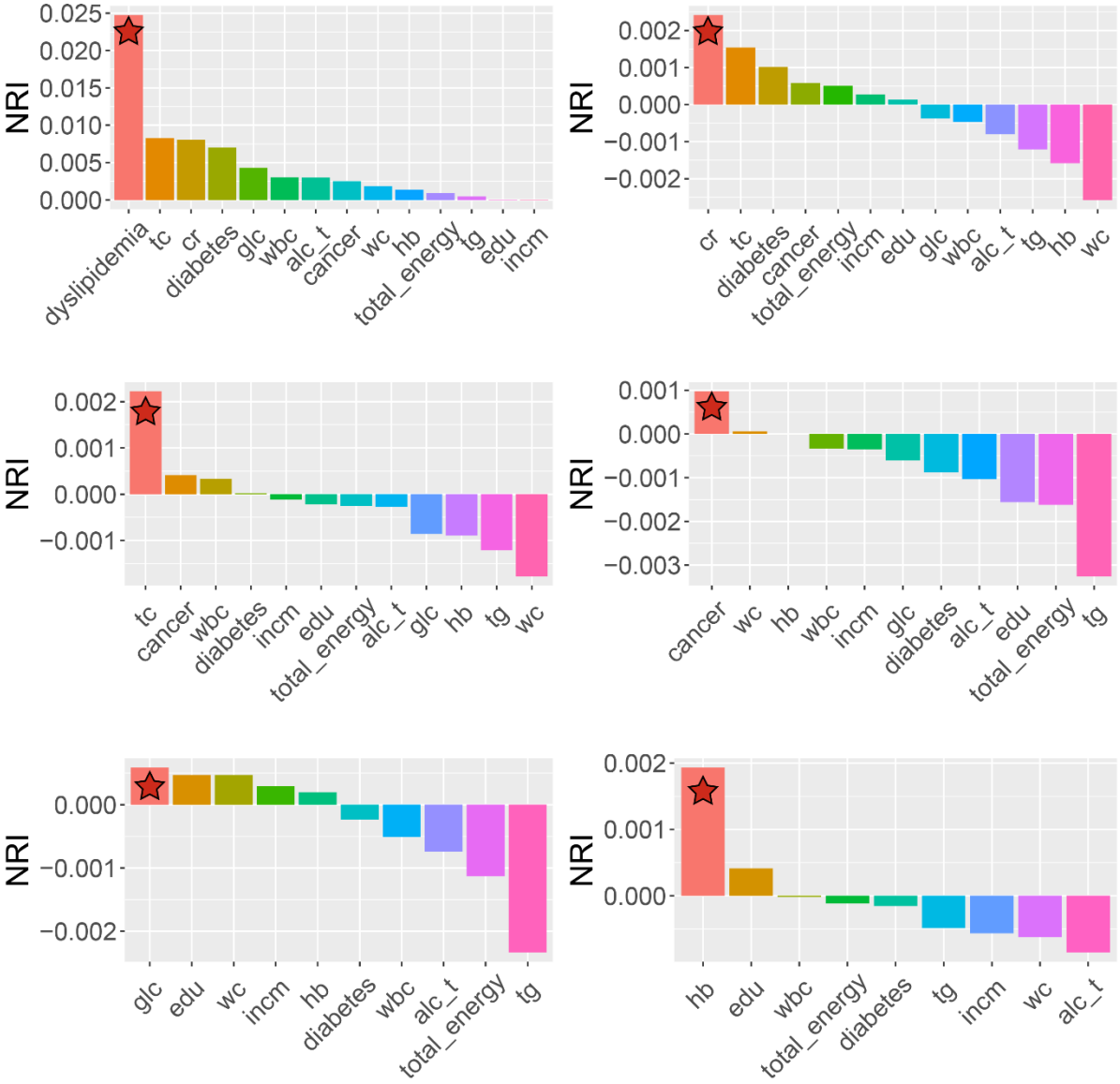
**Table S5. Baseline characteristics of external validation dataset (KoGES) by quintiles of hypertension probabilities in Korean women.**

| | Quantiles of hypertension probabilities | | | | | |
|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q5 | *P* for Trend |
| | n = 494 | n = 494 | n = 494 | n = 494 | n = 494 | |
| Range of probabilities | 0.0007 – 0.0218 | 0.0219 – 0.056 | 0.0561 – 0.1311 | 0.1314 – 0.2907 | 0.2908 – 0.9305 | |
| Age, years | 44.4 ± 0.2 | 46.7 ± 0.29 | 48.9 ± 0.33 | 52.1 ± 0.35 | 58.5 ± 0.34 | <.001 |
| Income, n | | | | | | <.001 |
| 1st quartile | 21 (4.3) | 46 (9.3) | 74 (15) | 99 (20) | 183 (37) | |
| 2nd quartile | 103 (20.9) | 135 (27.3) | 169 (34.2) | 192 (38.9) | 176 (35.6) | |
| 3rd quartile | 230 (46.6) | 201 (40.7) | 168 (34) | 138 (27.9) | 107 (21.7) | |
| 4th quartile | 140 (28.3) | 112 (22.7) | 83 (16.8) | 65 (13.2) | 28 (5.7) | |
| Education, n | | | | | | <.001 |
| Elementary school | 52 (10.5) | 104 (21.1) | 157 (31.8) | 216 (43.7) | 334 (67.6) | |
| Middle school | 121 (24.5) | 140 (28.3) | 147 (29.8) | 123 (24.9) | 86 (17.4) | |
| High school | 241 (48.8) | 199 (40.3) | 160 (32.4) | 128 (25.9) | 63 (12.8) | |
| University | 80 (16.2) | 51 (10.3) | 30 (6.1) | 27 (5.5) | 11 (2.2) | |
| Diabetes mellitus, n | 3 (0.6) | 8 (1.6) | 18 (3.6) | 15 (3) | 30 (6.1) | <.001 |
| Dyslipidemia, n | 4 (0.8) | 6 (1.2) | 7 (1.4) | 10 (2) | 11 (2.2) | .35 |
| Cancer, n | 15 (3) | 14 (2.8) | 15 (3) | 13 (2.6) | 4 (0.8) | .121 |
| Smoking, pack-years | 0.2 ± 0.06 | 0.3 ± 0.1 | 0.4 ± 0.15 | 0.1 ± 0.07 | 0.3 ± 0.1 | .909 |
| Alcohol consumption, g/week | 7.9 ± 1.06 | 11 ± 1.65 | 9.3 ± 1.42 | 11.5 ± 2.06 | 4.7 ± 0.92 | .013 |
| Total energy intake, kcal | 1934.4 ± 31.47 | 1936.7 ± 34.07 | 1935.9 ± 34.95 | 1928.3 ± 32.36 | 1846.1 ± 30.43 | .021 |
| BMI, kg/m2 | 22.8 ± 0.11 | 23.8 ± 0.12 | 24.6 ± 0.13 | 25.2 ± 0.15 | 25.5 ± 0.15 | <.001 |
| Waist circumference, cm | 73.6 ± 0.32 | 76.9 ± 0.36 | 79.9 ± 0.37 | 82.1 ± 0.4 | 84.6 ± 0.41 | <.001 |
| Systolic BP, mmHg | 95.4 ± 0.29 | 105.1 ± 0.24 | 111.2 ± 0.26 | 117.3 ± 0.26 | 126.4 ± 0.29 | <.001 |
| Diastolic BP, mmHg | 63.2 ± 0.28 | 70.4 ± 0.24 | 74.2 ± 0.24 | 77.6 ± 0.25 | 80.3 ± 0.25 | <.001 |
| FPG, mg/dL | 79.6 ± 0.5 | 81.3 ± 0.65 | 83.6 ± 0.8 | 84.2 ± 0.84 | 86.8 ± 0.9 | <.001 |
| Creatinine, mg/dL | 0.71842 ± 0.00393 | 0.73016 ± 0.00447 | 0.73239 ± 0.00454 | 0.74332 ± 0.00483 | 0.76012 ± 0.0053 | <.001 |
| Total cholesterol, mg/dL | 180.6 ± 1.37 | 182.7 ± 1.43 | 187.3 ± 1.51 | 193 ± 1.58 | 192.9 ± 1.65 | <.001 |
| Triglyceride, mg/dL | 111.2 ± 2.13 | 118.9 ± 2.46 | 137.1 ± 3.55 | 141.2 ± 3.28 | 157.2 ± 3.72 | <.001 |
| WBC, thousand/μL | 6 ± 0.07 | 6.1 ± 0.07 | 6.3 ± 0.08 | 6.1 ± 0.07 | 6.4 ± 0.08 | <.001 |
| Hb, g/dL | 12.2 ± 0.05 | 12.3 ± 0.05 | 12.4 ± 0.05 | 12.5 ± 0.05 | 12.7 ± 0.05 | <.001 |

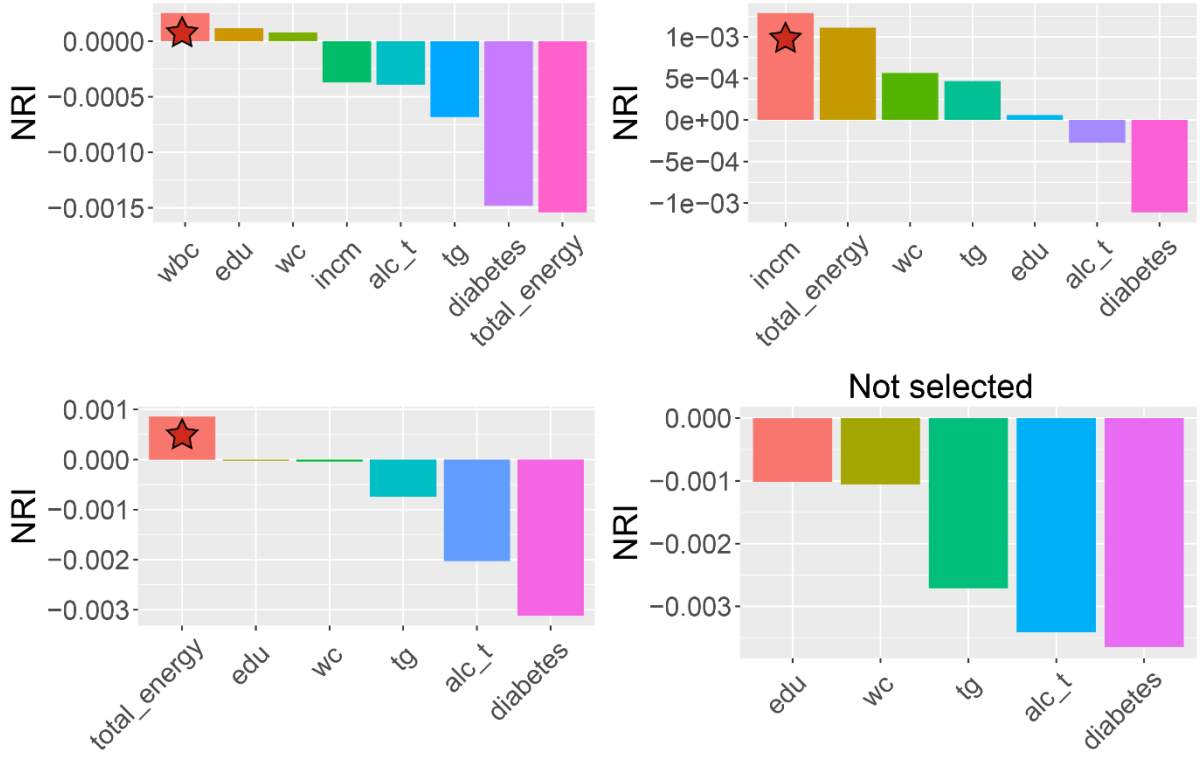
Continuous variables are presented as median ± standard error, and categorical variables are presented as numbers (percentage, %).

Abbreviations: KoGES, Korean Genome and Epidemiology Study; Q, quintile; BMI, body mass index; BP, blood pressure; FPG, fasting plasma glucose; WBC, white blood cells; Hb, hemoglobin.

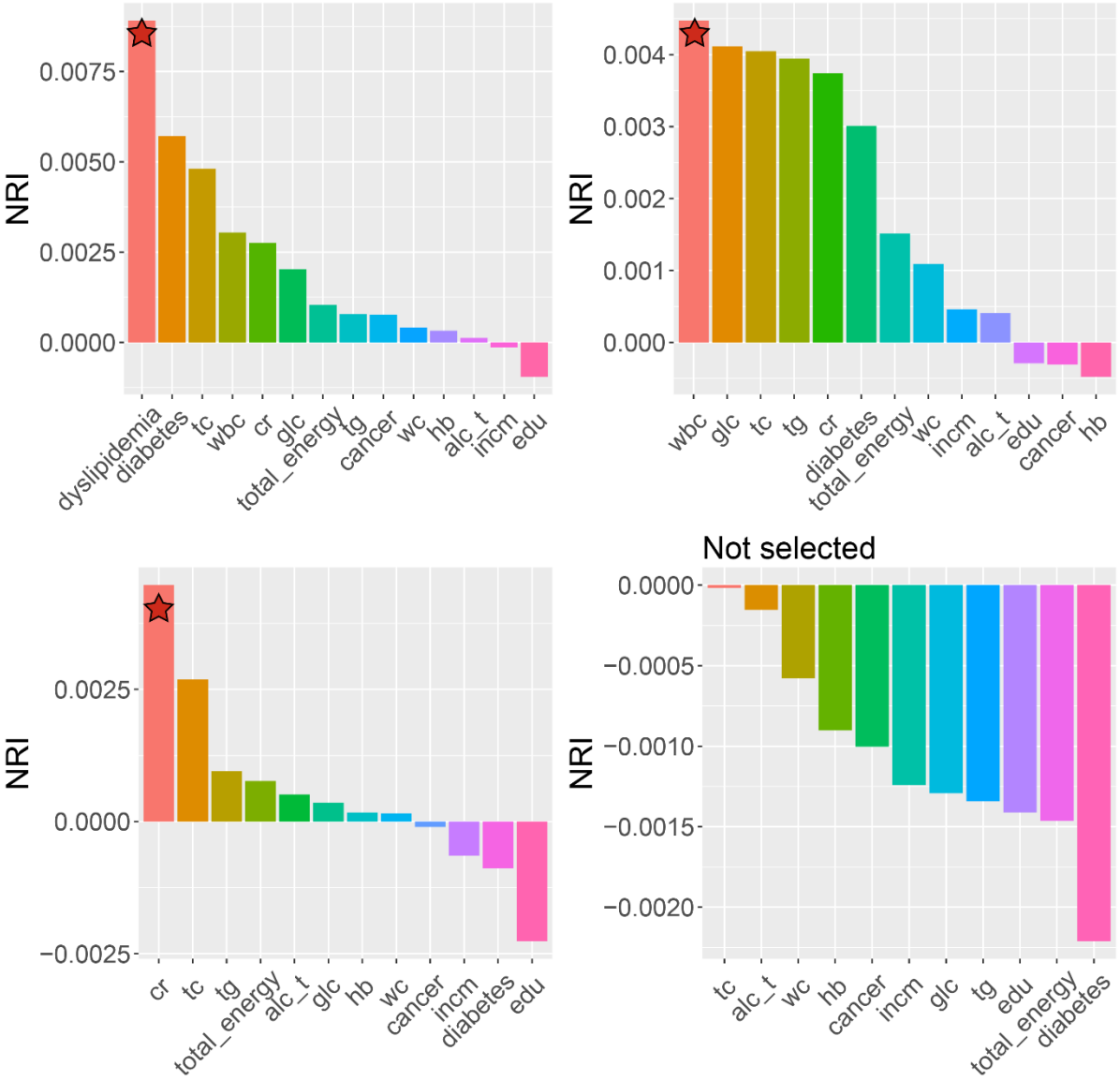
**Supplementary Figure S1. Predictors for Korean men selected by NRI method.**



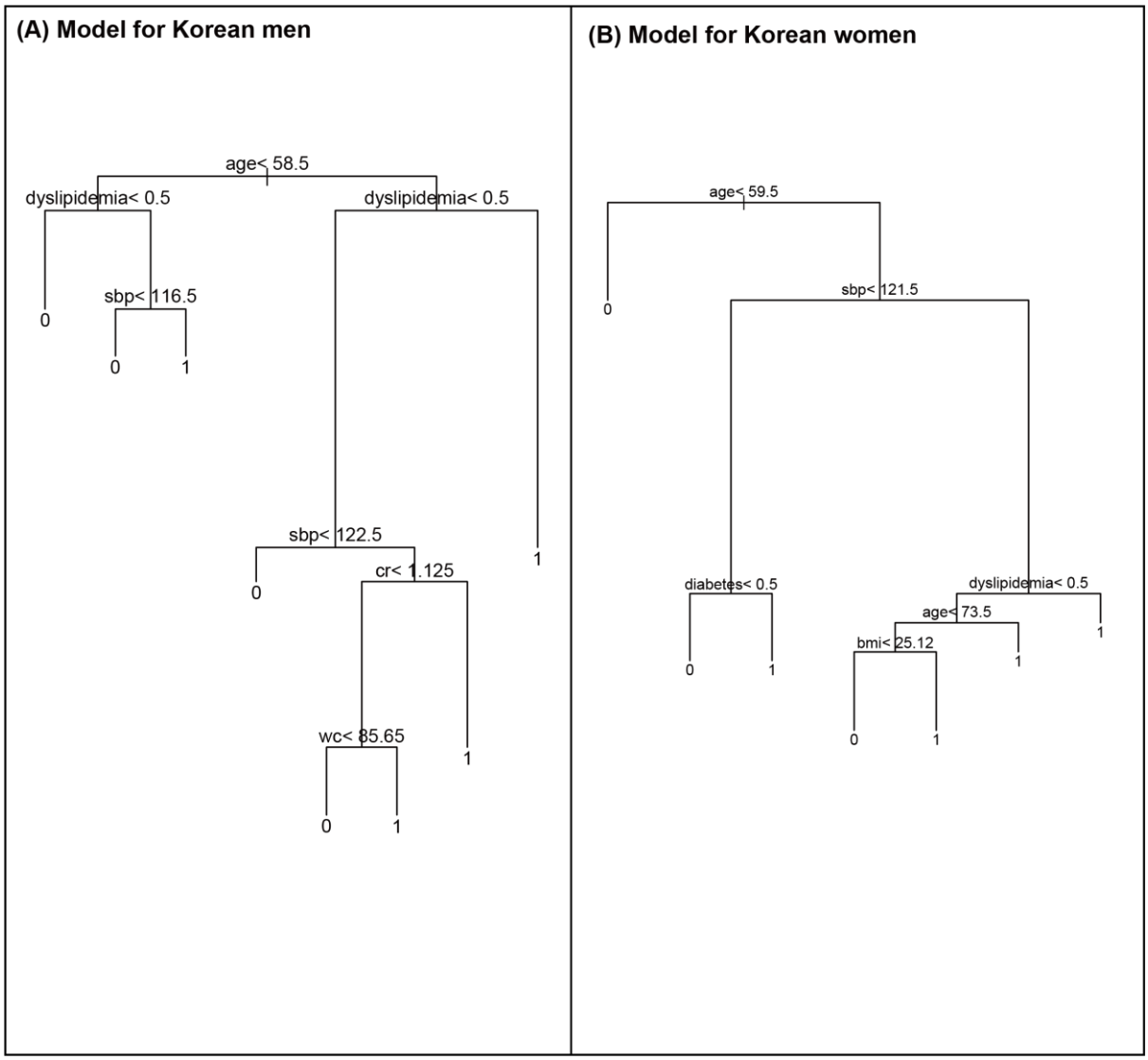
**Supplementary Figure S1. Predictors for Korean men selected by NRI method (Continued).**



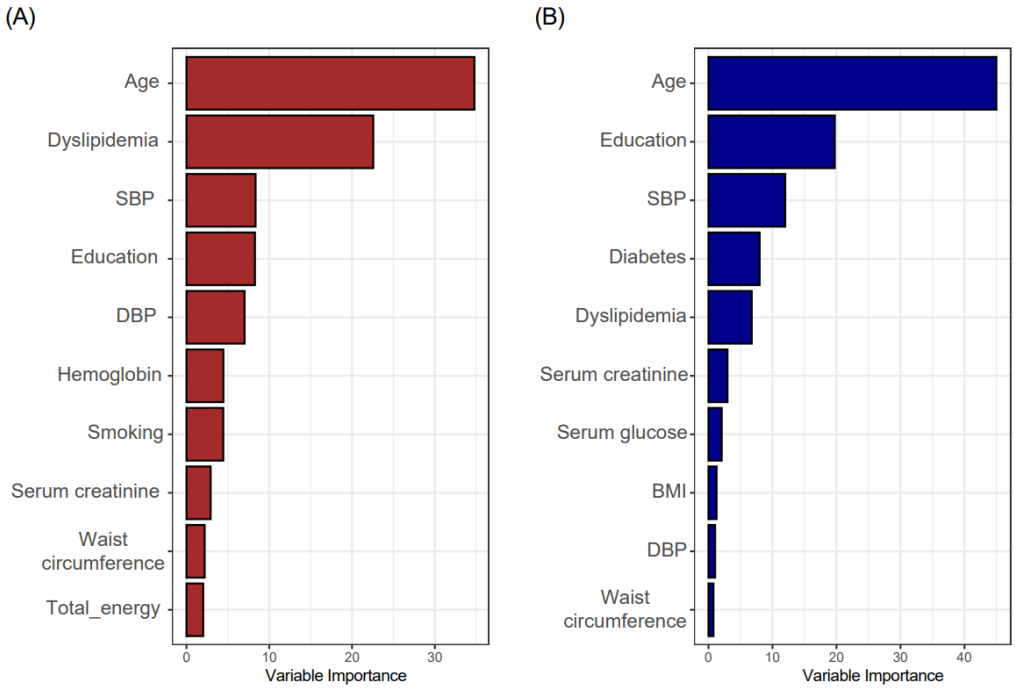
**Supplementary Figure S2. Predictors for Korean women selected by NRI method.**



**Supplementary Figure S3. CART analysis flowchart**



**Supplementary Figure S4. Variance importance of the sex-specific hypertension classification model measured by CART method. (A) Men (B) Women.**



**References**


1. Buford, T.W. Hypertension and aging. *Ageing Res. Rev.* **2016**, *26*, 96-111, doi:10.1016/j.arr.2016.01.007.
2. Di Giosia, P.; Giorgini, P.; Stamerra, C.A.; Petrarca, M.; Ferri, C.; Sahebkar, A. Gender differences in epidemiology, pathophysiology, and treatment of hypertension. *Curr. Atheroscler. Rep.* **2018**, *20*, 13, doi:10.1007/s11883-018-0716-z.
3. Gao, Y.; Chen, G.; Tian, H.; Lin, L.; Lu, J.; Weng, J.; Jia, W.; Ji, L.; Xiao, J.; Zhou, Z.; et al. Prevalence of hypertension in china: a cross-sectional study. *PLoS One* **2013**, *8*, e65938, doi:10.1371/journal.pone.0065938.
4. Hajjar, I.; Kotchen, T.A. Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988-2000. *JAMA* **2003**, *290*, 199-206, doi:10.1001/jama.290.2.199.
5. Pandit, A.U.; Tang, J.W.; Bailey, S.C.; Davis, T.C.; Bocchini, M.V.; Persell, S.D.; Federman, A.D.; Wolf, M.S. Education, literacy, and health: Mediating effects on hypertension knowledge and control. *Patient Educ. Couns.* **2009**, *75*, 381-385, doi:10.1016/j.pec.2009.04.006.
6. Leng, B.; Jin, Y.; Li, G.; Chen, L.; Jin, N. Socioeconomic status and hypertension: a meta-analysis. *J. Hypertens.* **2015**, *33*, 221-229, doi:10.1097/hjh.0000000000000428.
7. Tsimihodimos, V.; Gonzalez-Villalpando, C.; Meigs, J.B.; Ferrannini, E. Hypertension and Diabetes Mellitus: Coprediction and Time Trajectories. *Hypertension* **2018**, *71*, 422-428, doi:10.1161/hypertensionaha.117.10546.
8. Otsuka, T.; Takada, H.; Nishiyama, Y.; Kodani, E.; Saiki, Y.; Kato, K.; Kawada, T. Dyslipidemia and the risk of developing hypertension in a working-age male population. *J. Am. Heart Assoc.* **2016**, *5*, e003053, doi:10.1161/jaha.115.003053.
9. Han, H.; Guo, W.; Shi, W.; Yu, Y.; Zhang, Y.; Ye, X.; He, J. Hypertension and breast cancer risk: a systematic review and meta-analysis. *Sci. Rep.* **2017**, *7*, 44877, doi:10.1038/srep44877.
10. Liang, Z.; Xie, B.; Li, J.; Wang, X.; Wang, S.; Meng, S.; Ji, A.; Zhu, Y.; Xu, X.; Zheng, X.; et al. Hypertension and risk of prostate cancer: a systematic review and meta-analysis. *Sci. Rep.* **2016**, *6*, 31358, doi:10.1038/srep31358.
11. Hidayat, K.; Du, X.; Zou, S.Y.; Shi, B.M. Blood pressure and kidney cancer risk: meta-analysis of prospective studies. *J. Hypertens.* **2017**, *35*, 1333-1344, doi:10.1097/hjh.0000000000001286.
12. Gabin, J.M.; Tambs, K.; Saltvedt, I.; Sund, E.; Holmen, J. Association between blood pressure and Alzheimer disease measured up to 27 years prior to diagnosis: the HUNT Study. *Alzheimers Res. Ther.* **2017**, *9*, 37, doi:10.1186/s13195-017-0262-x.

13. Qiu, C.; Hu, G.; Kivipelto, M.; Laatikainen, T.; Antikainen, R.; Fratiglioni, L.; Jousilahti, P.; Tuomilehto, J. Association of blood pressure and hypertension with the risk of Parkinson disease: the National FINRISK Study. *Hypertension* **2011**, *57*, 1094-1100, doi:10.1161/hypertensionaha.111.171249.
14. Wang, Y.; Zeng, Y.; Lin, C.; Chen, Z. Hypertension and non-alcoholic fatty liver disease proven by transient elastography. *Hepatol. Res.* **2016**, *46*, 1304-1310, doi:10.1111/hepr.12688.
15. Primatesta, P.; Falaschetti, E.; Gupta, S.; Marmot, M.G.; Poulter, N.R. Association between smoking and blood pressure: evidence from the health survey for England. *Hypertension* **2001**, *37*, 187-193, doi:10.1161/01.hyp.37.2.187.
16. Xin, X.; He, J.; Frontini, M.G.; Ogden, L.G.; Motsamai, O.I.; Whelton, P.K. Effects of alcohol reduction on blood pressure: a meta-analysis of randomized controlled trials. *Hypertension* **2001**, *38*, 1112-1117, doi:10.1161/hy1101.093424.
17. Nakanishi, N.; Yoshida, H.; Nakamura, K.; Suzuki, K.; Tatara, K. Alcohol consumption and risk for hypertension in middle-aged Japanese men. *J. Hypertens.* **2001**, *19*, 851-855, doi:10.1097/00004872-200105000-00003.
18. Kelley, G.A.; Kelley, K.S. Progressive resistance exercise and resting blood pressure : A meta-analysis of randomized controlled trials. *Hypertension* **2000**, *35*, 838-843, doi:10.1161/01.hyp.35.3.838.
19. Whelton, S.P.; Chin, A.; Xin, X.; He, J. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Ann. Intern. Med.* **2002**, *136*, 493-503, doi:10.7326/0003-4819-136-7-200204020-00006.
20. Sacks, F.M.; Svetkey, L.P.; Vollmer, W.M.; Appel, L.J.; Bray, G.A.; Harsha, D.; Obarzanek, E.; Conlin, P.R.; Miller, E.R., 3rd; Simons-Morton, D.G.; et al. 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.* **2001**, *344*, 3-10, doi:10.1056/nejm200101043440101.
21. Vollmer, W.M.; Sacks, F.M.; Ard, J.; Appel, L.J.; Bray, G.A.; Simons-Morton, D.G.; Conlin, P.R.; Svetkey, L.P.; Erlinger, T.P.; Moore, T.J.; et al. Effects of diet and sodium intake on blood pressure: subgroup analysis of the DASH-sodium trial. *Ann. Intern. Med.* **2001**, *135*, 1019-1028, doi:10.7326/0003-4819-135-12-200112180-00005.

22. Appel, L.J.; Brands, M.W.; Daniels, S.R.; Karanja, N.; Elmer, P.J.; Sacks, F.M. Dietary approaches to prevent and treat hypertension: a scientific statement from the American Heart Association. *Hypertension* **2006**, *47*, 296-308, doi:10.1161/01.Hyp.0000202568.01167.B6.

23. Wang, Q.; Xi, B.; Liu, M.; Zhang, Y.; Fu, M. Short sleep duration is associated with hypertension risk among adults: a systematic review and meta-analysis. *Hypertens. Res.* **2012**, *35*, 1012-1018, doi:10.1038/hr.2012.91.

24. Staessen, J.; Bulpitt, C.J.; Fagard, R.; Lijnen, P.; Amery, A. The influence of menopause on blood pressure. *J. Hum. Hypertens.* **1989**, *3*, 427-433.

25. Zanchetti, A.; Facchetti, R.; Cesana, G.C.; Modena, M.G.; Pirrelli, A.; Sega, R. Menopause-related blood pressure increase and its relationship to age and body mass index: the SIMONA epidemiological study. *J. Hypertens.* **2005**, *23*, 2269-2276, doi:10.1097/01.hjh.0000194118.35098.43.

26. Chasan-Taber, L.; Willett, W.C.; Manson, J.E.; Spiegelman, D.; Hunter, D.J.; Curhan, G.; Colditz, G.A.; Stampfer, M.J. Prospective study of oral contraceptives and hypertension among women in the United States. *Circulation* **1996**, *94*, 483-489, doi:10.1161/01.cir.94.3.483.

27. He, J.; Whelton, P.K.; Appel, L.J.; Charleston, J.; Klag, M.J. Long-term effects of weight loss and dietary sodium reduction on incidence of hypertension. *Hypertension* **2000**, *35*, 544-549, doi:10.1161/01.hyp.35.2.544.

28. Neter, J.E.; Stam, B.E.; Kok, F.J.; Grobbee, D.E.; Geleijnse, J.M. Influence of weight reduction on blood pressure: a meta-analysis of randomized controlled trials. *Hypertension* **2003**, *42*, 878-884, doi:10.1161/01.Hyp.0000094221.86888.Ae.

29. Siani, A.; Cappuccio, F.P.; Barba, G.; Trevisan, M.; Farinaro, E.; Lacone, R.; Russo, O.; Russo, P.; Mancini, M.; Strazzullo, P. The relationship of waist circumference to blood pressure: the Olivetti Heart Study. *Am. J. Hypertens.* **2002**, *15*, 780-786, doi:10.1016/s0895-7061(02)02976-x.

30. Vasan, R.S.; Larson, M.G.; Leip, E.P.; Kannel, W.B.; Levy, D. Assessment of frequency of progression to hypertension in non-hypertensive participants in the Framingham Heart Study: a cohort study. *Lancet* **2001**, *358*, 1682-1686, doi:10.1016/s0140-6736(01)06710-1.

31. Leitschuh, M.; Cupples, L.A.; Kannel, W.; Gagnon, D.; Chobanian, A. High-normal blood pressure progression to hypertension in the Framingham Heart Study. *Hypertension* **1991**, *17*, 22-27, doi:10.1161/01.hyp.17.1.22.

32. Shankar, A.; Klein, B.E.; Klein, R. Relationship between white blood cell count and incident hypertension. *Am. J. Hypertens.* **2004**, *17*, 233-239, doi:10.1016/j.amjhyper.2003.11.005.

33. Emamian, M.; Hasanian, S.M.; Tayefi, M.; Bijari, M.; Movahedian Far, F.; Shafiee, M.; Avan, A.; Heidari-Bakavoli, A.; Moohebati, M.; Ebrahimi, M.; et al. Association of hematocrit with blood pressure and hypertension. *J. Clin. Lab. Anal.* **2017**, *31*, e22124, doi:10.1002/jcla.22124.

34. Geva, M.; Shlomai, G.; Berkovich, A.; Maor, E.; Leibowitz, A.; Tenenbaum, A.; Grossman, E. The association between fasting plasma glucose and glycated hemoglobin in the prediabetes range and future development of hypertension. *Cardiovasc. Diabetol.* **2019**, *18*, 53, doi:10.1186/s12933-019-0859-4.

35. Sesso, H.D.; Buring, J.E.; Chown, M.J.; Ridker, P.M.; Gaziano, J.M. A prospective study of plasma lipid levels and hypertension in women. *Arch. Intern. Med.* **2005**, *165*, 2420-2427, doi:10.1001/archinte.165.20.2420.

36. Tohidi, M.; Hatami, M.; Hadaegh, F.; Azizi, F. Triglycerides and triglycerides to high-density lipoprotein cholesterol ratio are strong predictors of incident hypertension in Middle Eastern women. *J. Hum. Hypertens.* **2012**, *26*, 525-532, doi:10.1038/jhh.2011.70.

37. Perneger, T.V.; Nieto, F.J.; Whelton, P.K.; Klag, M.J.; Comstock, G.W.; Szklo, M. A prospective study of blood pressure and serum creatinine. Results from the 'Clue' Study and the ARIC Study. *JAMA* **1993**, *269*, 488-493.

38. Lee, D.H.; Jacobs, D.R., Jr.; Gross, M.; Kiefe, C.I.; Roseman, J.; Lewis, C.E.; Steffes, M. Gamma-glutamyltransferase is a predictor of incident diabetes and hypertension: the Coronary Artery Risk Development in Young Adults (CARDIA) Study. *Clin. Chem.* **2003**, *49*, 1358-1366, doi:10.1373/49.8.1358.

39. Sesso, H.D.; Buring, J.E.; Rifai, N.; Blake, G.J.; Gaziano, J.M.; Ridker, P.M. C-reactive protein and the risk of developing hypertension. *JAMA* **2003**, *290*, 2945-2951, doi:10.1001/jama.290.22.2945.

40. Wang, T.J.; Gona, P.; Larson, M.G.; Levy, D.; Benjamin, E.J.; Tofler, G.H.; Jacques, P.F.; Meigs, J.B.; Rifai, N.; Selhub, J.; et al. Multiple biomarkers and the risk of incident hypertension. *Hypertension* **2007**, *49*, 432-438, doi:10.1161/01.HYP.0000256956.61872.aa.

41. Chamarthi, B.; Williams, G.H.; Ricchiuti, V.; Srikumar, N.; Hopkins, P.N.; Luther, J.M.; Jeunemaitre, X.; Thomas, A. Inflammation and hypertension: the interplay of interleukin-6, dietary sodium, and the renin-angiotensin system in humans. *Am. J. Hypertens.* **2011**, *24*, 1143-1148, doi:10.1038/ajh.2011.113.

42. Vasan, R.S.; Evans, J.C.; Larson, M.G.; Wilson, P.W.; Meigs, J.B.; Rifai, N.; Benjamin, E.J.; Levy, D. Serum aldosterone and the incidence of hypertension in nonhypertensive persons. *N. Engl. J. Med.* **2004**, *351*, 33-41, doi:10.1056/NEJMoa033263.

43. Wang, N.; Shao, H.; Chen, Y.; Xia, F.; Chi, C.; Li, Q.; Han, B.; Teng, Y.; Lu, Y. Follicle-stimulating hormone, its association with cardiometabolic risk factors, and 10-year risk of cardiovascular disease in postmenopausal women. *J. Am. Heart Assoc.* **2017**, *6*, e005918, doi:10.1161/jaha.117.005918.

44. Masi, C.M.; Hawkley, L.C.; Xu, X.; Veenstra, T.D.; Cacioppo, J.T. Serum estrogen metabolites and systolic blood pressure among middle-aged and older women and men. *Am. J. Hypertens.* **2009**, *22*, 1148-1153, doi:10.1038/ajh.2009.155.

45. Fogari, R.; Preti, P.; Zoppi, A.; Fogari, E.; Rinaldi, A.; Corradi, L.; Mugellini, A. Serum testosterone levels and arterial blood pressure in the elderly. *Hypertens. Res.* **2005**, *28*, 625-630, doi:10.1291/hypres.28.625.

46. Jacobs, D.R., Jr.; Yatsuya, H.; Hearst, M.O.; Thyagarajan, B.; Kalhan, R.; Rosenberg, S.; Smith, L.J.; Barr, R.G.; Duprez, D.A. Rate of decline of forced vital capacity predicts future arterial hypertension: the Coronary Artery Risk Development in Young Adults Study. *Hypertension* **2012**, *59*, 219-225, doi:10.1161/hypertensionaha.111.184101.

47. Engström, G.; Wollmer, P.; Valind, S.; Hedblad, B.; Janzon, L. Blood pressure increase between 55 and 68 years of age is inversely related to lung function: longitudinal results from the cohort study 'Men born in 1914'. *J. Hypertens.* **2001**, *19*, 1203-1208, doi:10.1097/00004872-200107000-00004.