

**Abstract Submission No. : 2062**

## **Kidney Injury Risk and Elevated Blood Pressure in Young Adults**

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**Objectives:** Elevated blood pressure (BP) is well-known risk factor for chronic kidney disease. However, the association between elevated BP and kidney injury is not well investigated in young adults. This study aimed to evaluate the association between BP categories based on 2017 American College of Cardiology/American Heart Association BP guideline and the risk of kidney injury among Korean young adults without history of hypertension.

**Methods:** Data were retrieved from the Korean National Health and Nutrition Examination Surveys (V-VII). Participants aged 20-39 years without history of hypertension or systolic BP (SBP) and diastolic BP (DBP) less than 140/90mmHg were included (N=8,180). Study subjects were categorized into normal BP (SBP <120 and DBP <80mmHg), elevated BP (SBP 120-129 and DBP <80mmHg) and stage 1 hypertension (SBP 130-139 or DBP 80-89mmHg). Study endpoint was kidney injury defined as eGFR <60mL/min/1.73m<sup>2</sup> or presence of proteinuria by dipstick urine test.

**Results:** The mean age of study subjects was 30.2 years and 45.3% were male. The mean SBP and DBP levels were 115.3/76.7 and 105.2/70.1mmHg in male and female subjects. The prevalence of kidney injury was 12.6% among study subjects and higher in the high BP category groups in both male and female. In multivariable logistic regression analysis for the risk of kidney injury, stage 1 hypertension group was associated with higher risk of kidney injury in both male and female (OR, 1.27; 95% CI, 1.04-1.61 and OR, 1.55; 95% CI, 1.19-2.01, normal BP as reference group).

**Conclusions:** This study showed stage 1 hypertension is associated with increased risk of kidney injury in young adults without history of hypertension. These results suggest young adults to control BP under 130/80 mmHg to prevent future kidney disease development.

Table 1. Baseline Characteristics

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| Characteristics                          | Total<br>(n=8,180) | Blood pressure group               |                                    |                                   | P      |
|--|--------------------|------------------------------------|------------------------------------|-----------------------------------|--------|
|  |                    | Normal blood pressure<br>(n=5,938) | Elevated blood pressure<br>(n=359) | Stage 1 hypertension<br>(n=1,883) |        |
| <b>Demographic data</b>                  |                    |                                    |                                    |                                   |        |
| Male, n(%)                               | 3709 (45.3)        | 2068 (34.8)                        | 283 (78.8)                         | 1358 (72.1)                       | <0.001 |
| Age, years                               | 30.2 ± 6.1         | 29.9 ± 6.2                         | 28.1 ± 6.2                         | 31.5 ± 5.8                        | <0.001 |
| Age, group, n(%)                         |                    |                                    |                                    |                                   | <0.001 |
| 19-24                                    | 1961 (24.0)        | 1509 (25.4)                        | 134 (37.3)                         | 318 (16.9)                        |        |
| 25-29                                    | 1590 (19.4)        | 1189 (20.0)                        | 75 (20.9)                          | 326 (17.3)                        |        |
| 30-34                                    | 2022 (24.7)        | 1455 (24.5)                        | 73 (20.3)                          | 494 (26.2)                        |        |
| 35-39                                    | 2607 (31.9)        | 1785 (30.1)                        | 77 (21.4)                          | 745 (39.6)                        |        |
| CVD family history, n(%)                 | 673 (8.2)          | 471 (7.9)                          | 22 (6.1)                           | 180 (9.6)                         | 0.027  |
| Current smoker, n (%)                    | 1868 (22.8)        | 1140 (19.2)                        | 105 (29.2)                         | 623 (33.1)                        | <0.001 |
| Heavy drinking, n (%)                    | 1183 (14.5)        | 654 (11.0)                         | 80 (22.3)                          | 449 (23.8)                        | <0.001 |
| BMI, kg/m <sup>2</sup>                   | 23.19 ± 3.9        | 22.35 ± 3.4                        | 24.7 ± 3.9                         | 25.5 ± 4.4                        | <0.001 |
| BMI group                                |                    |                                    |                                    |                                   | <0.001 |
| < 18.5 kg/m <sup>2</sup> (%)             | 7.6                | 9.4                                | 3.9                                | 2.7                               |        |
| 18.5-22.9 kg/m <sup>2</sup> (%)          | 46.9               | 53.9                               | 33.1                               | 27.8                              |        |
| 23-24.9 kg/m <sup>2</sup> (%)            | 17.9               | 17.3                               | 22.6                               | 18.6                              |        |
| ≥25 kg/m <sup>2</sup> (%)                | 27.6               | 19.4                               | 40.4                               | 51.0                              |        |
| SBP, mmHg                                | 109.7 ± 11.7       | 104.6 ± 7.4                        | 123.0 ± 2.7                        | 123.4 ± 10.9                      | <0.001 |
| DBP, mmHg                                | 73.1 ± 9.5         | 69.0 ± 6.3                         | 73.2 ± 5.2                         | 86.0 ± 6.7                        | <0.001 |
| Diabetes, n(%)                           | 40 (0.5)           | 25 (0.4)                           | 4 (0.4)                            | 11 (0.6)                          | 0.150  |
| Kidney injury, n(%)                      | 1029 (12.6)        | 698 (11.8)                         | 50 (13.9)                          | 281 (14.9)                        | 0.001  |
| <b>Laboratory data</b>                   |                    |                                    |                                    |                                   |        |
| eGFR(MDRD), mL/min/1.73 m <sup>2</sup>   | 105.5 ± 17.4       | 106.6 ± 17.5                       | 105.1 ± 16.8                       | 101.8 ± 16.4                      | <0.001 |
| eGFR<60mL/min/1.73 m <sup>2</sup> , n(%) | 5 (0.1)            | 3 (0.1)                            | 1 (0.3)                            | 1 (0.1)                           | 0.234  |
| Proteinuria, n(%)                        | 1025 (12.5)        | 695 (11.7)                         | 50 (13.9)                          | 280 (14.9)                        | 0.001  |
| Urine dipstick                           |                    |                                    |                                    |                                   | 0.002  |
| negative (%)                             | 87.5               | 88.3                               | 86.1                               | 85.1                              |        |
| trace (%)                                | 11.4               | 10.8                               | 12.5                               | 13.2                              |        |
| ≥1+ (%)                                  | 1.1                | 0.9                                | 1.4                                | 1.7                               |        |
| Hemoglobin, g/dL                         | 14.2 ± 1.7         | 13.9 ± 1.6                         | 15.1 ± 1.4                         | 15.2 ± 1.5                        | <0.001 |
| Anemia, n(%)                             | 634 (7.8)          | 558 (9.4)                          | 13 (3.6)                           | 63 (3.3)                          | <0.001 |
| Fasting plasma glucose, g/dL             | 91.6 ± 13.8        | 90.1 ± 11.6                        | 93.5 ± 14.1                        | 95.9 ± 18.4                       | <0.001 |
| HbA1c, %                                 | 5.37 ± 0.46        | 5.34 ± 0.41                        | 5.39 ± 0.48                        | 5.46 ± 0.60                       | <0.001 |
| Total cholesterol, mg/dL                 | 184.1 ± 32.7       | 180.5 ± 31.6                       | 184.9 ± 31.3                       | 195.2 ± 33.6                      | <0.001 |
| LDL-C(calculated), mg/dL                 | 108.7 ± 28.7       | 106.5 ± 27.6                       | 109.2 ± 29.5                       | 115.7 ± 30.1                      | <0.001 |
| HDL-C, mg/dL                             | 53.9 ± 12.2        | 55.0 ± 12.1                        | 51.7 ± 11.8                        | 50.8 ± 12.2                       | <0.001 |
| Triglyceride, mg/dL                      | 107.4 ± 65.8       | 95.1 ± 56.2                        | 119.7 ± 67.3                       | 143.7 ± 78.6                      | <0.001 |

**Note:** Data are presented as mean ± SD, median [IQR], or number (%).

**Abbreviations:** BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; CVD, cardiovascular disease; eGFR, estimated glomerular filtration rate; LDL-C, low density lipoprotein-cholesterol; HDL-C, high density lipoprotein-cholesterol; SD, standard deviation; IQR, interquartile range.


  
**KSN 2021**
  
**FULLY VIRTUAL MEETING**
  
 September 02 (Thu) - 05 (Sun)

Table 2. Risk of Kidney Injury According to Blood Pressure Group

| <b>Table 2. Risk of Kidney Injury According to Blood Pressure Group</b>  |                     |          |                     |          |
|--|---------------------|----------|---------------------|----------|
|  | <b>Model 1</b>      |          | <b>Model 2</b>      |          |
|  | <b>OR (95% CI)</b>  | <b>P</b> | <b>OR (95% CI)</b>  | <b>P</b> |
| <b>Total</b>   |                     |          |                     |          |
| SBP (Per 1 mmHg increase)  | 1.009 (1.004-1.015) | 0.001    | 1.010 (1.004-1.017) | 0.001    |
| DBP (Per 1 mmHg increase)  | 1.017 (1.010-1.024) | <0.001   | 1.022 (1.015-1.030) | <0.001   |
| <b>Blood pressure group</b>  |                     |          |                     |          |
| Normal blood pressure  | (Reference)         |          |                     |          |
| Elevated blood pressure  | 1.215 (0.892-1.655) | 0.217    | 1.181 (0.858-1.624) | 0.307    |
| Stage 1 hypertension   | 1.317 (1.134-1.529) | 0.000    | 1.388 (1.174-1.641) | 0.000    |
| <b>Male</b>  |                     |          |                     |          |
| SBP (Per 1 mmHg increase)  | 1.010 (1.002-1.019) | 0.019    | 1.009 (1.000-1.018) | 0.042    |
| DBP (Per 1 mmHg increase)  | 1.016 (1.006-1.026) | 0.002    | 1.019 (1.008-1.030) | 0.001    |
| <b>Blood pressure group</b>  |                     |          |                     |          |
| Normal blood pressure  | (Reference)         |          |                     |          |
| Elevated blood pressure  | 1.266 (0.882-1.815) | 0.200    | 1.212 (0.841-1.747) | 0.303    |
| Stage 1 hypertension   | 1.274 (1.038-1.561) | 0.020    | 1.294 (1.042-1.608) | 0.020    |
| <b>Female</b>  |                     |          |                     |          |
| SBP (Per 1 mmHg increase)  | 1.012 (1.004-1.021) | 0.005    | 1.012 (1.003-1.021) | 0.01     |
| DBP (Per 1 mmHg increase)  | 1.023 (1.012-1.033) | <0.001   | 1.026 (1.014-1.037) | <0.001   |
| <b>Blood pressure group</b>  |                     |          |                     |          |
| Normal blood pressure  | (Reference)         |          |                     |          |
| Elevated blood pressure  | 1.123 (0.573-2.200) | 0.735    | 1.052 (0.533-2.079) | 0.883    |
| Stage 1 hypertension   | 1.493 (1.164-1.915) | 0.002    | 1.550 (1.194-2.011) | 0.001    |
| <b>Note:</b> Model 1: Unadjusted model   |                     |          |                     |          |
| Model 2: Adjusted for age, sex, smoking and alcohol status, family history of cardiovascular disease, obesity(BMI $\geq$ 25), anemia(male $\leq$ 13g/dL or female $\leq$ 12g/dL), LDL, and HbA1c                   |                     |          |                     |          |
| <b>Abbreviations:</b> BMI, body mass index; OR, odds ratio; CI, confidence interval; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate |                     |          |                     |          |