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**Pre-Hypertension Prevalence and Associated Factors: A Cross-Sectional Study among Healthy Adults Living in Urban, Semi-Urban and Rural Areas of Yogyakarta-Indonesia**

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**Objectives:** Prehypertension which was not detected, is considered as a precursor of hypertension and may be related to several factors. The prevalence may also differ between dwelling areas. We aim to investigate the association between prehypertension and associated factors in five different setting areas in Yogyakarta Province

**Methods:** Cross-sectional study, conducted on 2016 – 2018 and involved 543 healthy adults 19–64 years of age in five different setting areas in Yogyakarta Province, represented urban, semi-urban and rural (consists of mountainous, coast and lowland area). Primary data: interviewed sociodemographic, dietary pattern and physical activity; assessed body mass index (BMI) and blood pressure. Pregnant or breastfeeding participant was excluded. We used JNC 7 to categorize blood pressure into two groups, prehypertension when systolic is 120-139 mmHg or diastolic is 80-89 mmHg; and normal when systolic is <120 mmHg or diastolic <80 mmHg.

**Results:** Prehypertension is higher in all different dwelling areas. Regardless of the dwelling—since the trend is the same in urban, semi-urban and rural, the trend of prehypertension is higher on male, older adult, uneducated, physically workers, have family history on NCDs, and often in consuming high sugar-contained food. In semi-urban, higher prevalence of prehypertension is more in less total fruits and vegetables intake and often consumption of salt and processed-contained food.

**Conclusions:** All dwelling areas have higher prevalence of prehypertension. Regardless of the dwelling, factors that have higher prevalence of prehypertension are male, older adult, uneducated, physically workers, have family history on NCDs, and often in consuming high sugar-contained food.

Table 1. Participants Characteristics based on Dwelling Area

| Characteristics                                     | Dwelling Areas   |                       |                   |                       |                 |
|---|------------------|-----------------------|-------------------|-----------------------|-----------------|
|   | Urban<br>(n=196) | Semi-urban<br>(n=101) | Lowland<br>(n=88) | Mountainous<br>(n=88) | Coast<br>(n=70) |
|   | %                | %                     | %                 | %                     | %               |
| <b>Sex</b>  |                  |                       |                   |                       |                 |
| - Male  | 45.9             | 33.0                  | 49.5              | 45.5                  | 31.4            |
| - Female  | 54.1             | 67.0                  | 50.5              | 54.5                  | 68.6            |
| <b>Age</b>  |                  |                       |                   |                       |                 |
| - Adult   | 26.0             | 22.7                  | 26.7              | 22.7                  | 18.6            |
| - Middle adult                                      | 51.0             | 52.3                  | 52.5              | 45.5                  | 58.6            |
| - Older adult                                       | 23.0             | 25.0                  | 20.8              | 31.8                  | 22.9            |
| <b>Education Degree</b>                             |                  |                       |                   |                       |                 |
| - Uneducated  | 1.0              | 0.0                   | 2.0               | 4.5                   | 5.7             |
| - Elementary school                                 | 13.3             | 11.4                  | 16.8              | 21.6                  | 22.9            |
| - Middle school                                     | 60.7             | 17.0                  | 60.4              | 65.9                  | 65.7            |
| - Under-graduate                                    | 21.9             | 47.7                  | 47.5              | 6.8                   | 37.1            |
| - Post-graduate                                     | 3.1              | 23.9                  | 20.8              | 1.1                   | 5.7             |
| <b>Occupation</b>                                   |                  |                       |                   |                       |                 |
| - Unemployed/Housewife                              | 37.7             | 26.1                  | 33.7              | 35.2                  | 25.7            |
| - Students  | 6.6              | 4.5                   | 1.0               | 1.1                   | 0.0             |
| - Civil servant                                     | 4.2              | 5.7                   | 0.0               | 1.1                   | 27.1            |
| - Private office                                    | 10.7             | 8.0                   | 7.9               | 6.8                   | 1.4             |
| - Entrepreneur                                      | 22.4             | 35.2                  | 12.9              | 11.4                  | 7.1             |
| - Farmers/Labours                                   | 18.4             | 20.5                  | 44.5              | 44.4                  | 38.5            |
| <b>Family History of Diseases</b>                   |                  |                       |                   |                       |                 |
| - None  | 53.1             | 45.5                  | 66.3              | 64.8                  | 75.7            |
| - Diabetes mellitus                                 | 15.8             | 15.9                  | 8.9               | 10.2                  | 5.7             |
| - Hypertension                                      | 21.4             | 22.7                  | 20.8              | 19.3                  | 14.3            |
| - Cardiovascular diseases                           | 2.6              | 8.0                   | 2.0               | 1.1                   | 1.4             |
| - Stroke  | 5.1              | 2.3                   | 1.0               | 4.5                   | 2.9             |
| - Others*   | 2.0              | 5.7                   | 1.0               | 0.0                   | 0.0             |
| <b>Smoking</b>                                      |                  |                       |                   |                       |                 |
| - Yes   | 36.2             | 25.0                  | 31.7              | 34.1                  | 22.9            |
| - No  | 63.8             | 75.0                  | 68.3              | 65.9                  | 77.1            |
| <b>Blood pressure</b>                               |                  |                       |                   |                       |                 |
| - Prehypertension                                   | 63.8             | 63.6                  | 74.3              | 76.1                  | 67.1            |
| - Normal  | 36.2             | 36.4                  | 25.7              | 23.9                  | 32.9            |
| <b>BMI**</b>  |                  |                       |                   |                       |                 |
| - Underweight                                       | 0.0              | 0.0                   | 0.0               | 0.0                   | 0.0             |
| - Normoweight                                       | 60.7             | 51.1                  | 63.4              | 75.0                  | 70.0            |
| - Overweight/Obesity                                | 39.3             | 48.9                  | 36.6              | 25.0                  | 30.0            |
| <b>Physical activity</b>                            |                  |                       |                   |                       |                 |
| - Light   | 73.0             | 71.6                  | 61.4              | 55.7                  | 48.6            |
| - Medium  | 25.5             | 26.1                  | 32.7              | 40.9                  | 37.1            |
| - Heavy   | 1.5              | 2.3                   | 5.9               | 3.4                   | 14.3            |
| <b>Total consumption of FV***</b>                   |                  |                       |                   |                       |                 |
| - < 3.5 portion/day                                 | 85.2             | 89.8                  | 89.1              | 86.4                  | 92.9            |
| - ≥ 3.5 portion/day                                 | 14.8             | 10.2                  | 10.9              | 13.6                  | 7.1             |
| <b>Consumption of high sugar contained-food****</b> |                  |                       |                   |                       |                 |
| - Often   | 70.9             | 21.6                  | 80.2              | 83.0                  | 2.9             |
| - Sometimes   | 22.4             | 56.8                  | 11.9              | 10.2                  | 70.0            |
| - Rare  | 6.6              | 21.6                  | 7.9               | 6.8                   | 27.1            |
| <b>Consumption of high salt contained-food****</b>  |                  |                       |                   |                       |                 |
| - Often   | 10.2             | 39.8                  | 24.8              | 17.0                  | 17.1            |
| - Sometimes   | 37.8             | 48.9                  | 30.7              | 35.2                  | 74.3            |
| - Rare  | 52.0             | 11.4                  | 44.6              | 47.7                  | 8.6             |
| <b>Consumption of high fat contained-food****</b>   |                  |                       |                   |                       |                 |
| - Often   | 49.5             | 60.2                  | 55.4              | 53.4                  | 24.3            |
| - Sometimes   | 42.9             | 38.6                  | 41.6              | 44.3                  | 71.4            |
| - Rare  | 7.7              | 1.1                   | 3.0               | 2.3                   | 4.3             |
| <b>Consumption of high processed-food****</b>       |                  |                       |                   |                       |                 |
| - Often   | 2.0              | 5.7                   | 2.0               | 3.4                   | 0.0             |
| - Sometimes   | 26.0             | 38.6                  | 26.7              | 17.0                  | 25.7            |
| - Rare  | 71.9             | 55.7                  | 71.3              | 79.5                  | 74.3            |

\*Others: family history of communicable diseases (ex: tuberculosis)

\*\*BMI: Body Mass Index (kg/m<sup>2</sup>). Underweight: <18.5 kg/m<sup>2</sup>; Normoweight: 18.5 – 23.5 kg/m<sup>2</sup>; Overweight and obesity: >23.5 kg/m<sup>2</sup>

\*\*\*FV: Fruits and Vegetables. Cut-off portion is obtained from Indonesia Nutrition Balanced Diet Recommended by Ministry of Health through Indonesian Diet Pyramid, which is fruits consumption should be minimal 3 portion/day and vegetables 4 portion/day. We made an average intake of those two.

\*\*\*\*Frequency of consumption is adapted from Ministry of Health of Indonesia through Indonesia Basic Health Survey 2013. Often: 1x/day or >1x/day, Sometimes: 3-6x/week or 1-2x/week, Rare: <3x/month or never

Table 2. Prehypertension and Its Associated Factors based on Dwelling Area

Table 2. Factor Associated with Prehypertension in Different Dwelling (n=543)

| Variables   | Urban                    |                |                       | Semi-urban  |                |                        | Rural       |                |                       |
|---|--------------------------|----------------|-----------------------|-------------|----------------|------------------------|-------------|----------------|-----------------------|
|   | Pre-HT <sup>a</sup><br>% | P <sup>a</sup> | OR<br>(95% CI)        | Pre-HT<br>% | P <sup>a</sup> | OR<br>(95% CI)         | Pre-HT<br>% | P <sup>a</sup> | OR<br>(95% CI)        |
| <b>Sex</b>  |                          |                |                       |             |                |                        |             |                |                       |
| Male  | 77.8                     | <0.001         | 3.24<br>(1.73 – 6.07) | 82.8        | 0.009          | 4.05<br>(1.36 – 12.06) | 85.7        | <0.001         | 3.48<br>(1.86 – 6.52) |
| Female  | 51.9                     |                |                       | 54.2        |                |                        | 63.3        |                |                       |
| <b>Age</b>  |                          |                |                       |             |                |                        |             |                |                       |
| Adult   | 60.9                     | 0.129          | 0.57<br>(0.27 – 1.19) | 62.1        | 0.609          | 0.77<br>(0.27 – 2.13)  | 69.6        | 0.034          | 0.47<br>(0.23 – 0.95) |
| Older adult   | 73.3                     |                |                       | 68.2        |                |                        | 83.1        |                |                       |
| <b>Education degree<sup>b</sup></b>                         |                          |                |                       |             |                |                        |             |                |                       |
| Uneducated  | 64.3                     | 0.952          | 1.03<br>(0.44 – 2.36) | 50.0        | 0.341          | 0.53<br>(0.14 – 1.99)  | 77.4        | 0.366          | 1.36<br>(0.67 – 2.66) |
| Educated  | 63.7                     |                |                       | 65.4        |                |                        | 71.6        |                |                       |
| <b>Occupation<sup>c</sup></b>                               |                          |                |                       |             |                |                        |             |                |                       |
| Sedentary   | 61.9                     | 0.243          | 0.62<br>(0.28 – 1.38) | 59.0        | 0.417          | 0.70<br>(0.29 – 1.67)  | 67.8        | 0.039          | 0.55<br>(0.31 – 0.97) |
| Physically workers  | 72.2                     |                |                       | 67.2        |                |                        | 79.3        |                |                       |
| <b>Family history of diseases</b>                           |                          |                |                       |             |                |                        |             |                |                       |
| NCD <sup>d</sup>  | 65.2                     | 0.693          | 0.89<br>(0.49 – 1.60) | 64.6        | 0.840          | 0.91<br>(0.38 – 2.20)  | 75.6        | 0.515          | 0.82<br>(0.45 – 1.49) |
| None  | 62.5                     |                |                       | 62.5        |                |                        | 71.8        |                |                       |
| <b>Smoking</b>  |                          |                |                       |             |                |                        |             |                |                       |
| Yes   | 70.4                     | 0.145          | 1.59<br>(0.85 – 2.96) | 68.2        | 0.609          | 1.31<br>(0.47 – 3.64)  | 83.3        | 0.014          | 2.23<br>(1.17 – 4.50) |
| No  | 60.0                     |                |                       | 62.1        |                |                        | 68.5        |                |                       |
| <b>Body Mass Index</b>                                      |                          |                |                       |             |                |                        |             |                |                       |
| Normoweight   | 66.2                     | 0.570          | 0.84<br>(0.46 – 1.53) | 65.1        | 0.780          | 0.88<br>(0.37 – 2.11)  | 68.8        | 0.310          | 1.35<br>(0.76 – 2.42) |
| Overweight/ Obesity   | 62.2                     |                |                       | 62.2        |                |                        | 74.9        |                |                       |
| <b>Physical Activity<sup>d</sup></b>                        |                          |                |                       |             |                |                        |             |                |                       |
| Sedentary   | 66.4                     | 0.200          | 1.52<br>(0.80 – 2.89) | 60.3        | 0.300          | 0.59<br>(0.22 – 1.62)  | 73.8        | 0.740          | 1.10<br>(0.63 – 1.91) |
| Active  | 56.6                     |                |                       | 72.0        |                |                        | 71.9        |                |                       |
| <b>Total consumption of FV</b>                              |                          |                |                       |             |                |                        |             |                |                       |
| < 3.5 portion/day   | 62.9                     | 0.529          | 0.76<br>(0.33 – 1.78) | 65.8        | 0.207          | 2.41<br>(0.60 – 9.71)  | 72.3        | 0.480          | 0.71<br>(0.23 – 1.84) |
| ≥3.5 portion/day  | 69.0                     |                |                       | 44.4        |                |                        | 78.6        |                |                       |
| <b>Consumption of high sugar contained-food<sup>e</sup></b> |                          |                |                       |             |                |                        |             |                |                       |
| Often   | 64.1                     | 0.836          | 1.09<br>(0.48 – 2.46) | 63.9        | 0.967          | 1.02<br>(0.42 – 2.47)  | 77.7        | 0.006          | 2.26<br>(1.26 – 4.07) |
| Rare  | 62.1                     |                |                       | 63.5        |                |                        | 60.6        |                |                       |
| <b>Consumption of high salt contained-food<sup>e</sup></b>  |                          |                |                       |             |                |                        |             |                |                       |
| Often   | 63.3                     | 0.932          | 0.97<br>(0.50 – 1.90) | 67.3        | 0.360          | 1.51<br>(0.62 – 3.69)  | 72.4        | 0.882          | 0.96<br>(0.54 – 1.69) |
| Rare  | 63.9                     |                |                       | 57.6        |                |                        | 73.3        |                |                       |
| <b>Consumption of high fat contained-food<sup>e</sup></b>   |                          |                |                       |             |                |                        |             |                |                       |
| Often   | 65.8                     | 0.301          | 1.42<br>(0.73 – 2.78) | 62.5        | 0.638          | 0.76<br>(0.24 – 2.42)  | 72.8        | 0.891          | 0.95<br>(0.49 – 1.86) |
| Rare  | 57.4                     |                |                       | 68.8        |                |                        | 73.7        |                |                       |
| <b>Consumption of high processed-food<sup>e</sup></b>       |                          |                |                       |             |                |                        |             |                |                       |
| Often   | 46.2                     | 0.045          | 0.43<br>(0.12 – 0.99) | 75.0        | 0.379          | 1.85<br>(0.46 – 7.40)  | 72.2        | 0.941          | 0.96<br>(0.33 – 2.80) |
| Rare  | 66.5                     |                |                       | 61.8        |                |                        | 73.0        |                |                       |

<sup>a</sup>Pre-HT; Pre-hypertension, NCD; Non-communicable diseases (diabetes mellitus, hypertension, cardiovascular diseases and stroke).

<sup>b</sup>Rural is defined as group of dwelling from lowland area, mountainous and coast

<sup>c</sup>Chi-square test; p is significantly associated if <0.05,

<sup>d</sup>OR after re-grouping into 2 categories (Uneducated, which is uneducated, elementary school; and Educated, which is middle-school and university degrees),

<sup>e</sup>OR after re-grouping into 2 categories (Sedentary and Physically workers)

<sup>f</sup>OR after re-grouping into 2 categories (Sedentary, which is light category and Active, which is medium and heavy category)

<sup>g</sup>OR after re-grouping into 2 categories (Often, which is 1x/day, >1x/day and 3-6x/week; and Rare, which is 1-2x/week, <3x/month and never)