



Epidemiology of High Blood Pressure in Children and Adolescents

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Hypertension **Key facts**

- Hypertension - or elevated blood pressure - is a serious medical condition that significantly increases the risks of heart, brain, kidney and other diseases.
- An estimated 1.13 billion people worldwide have hypertension, most (two-thirds) living in low- and middle-income countries.
- In 2015, 1 in 4 men and 1 in 5 women had hypertension.

Hypertension **Key facts**

- Fewer than 1 in 5 people with hypertension have the problem under control.
- Hypertension is a major cause of premature death worldwide.
- One of the global targets for noncommunicable diseases is to reduce the prevalence of hypertension by 25% by 2025 (baseline 2010).

Hypertension **Key facts**

- High blood pressure in children and adolescents is a growing health problem, along with the worldwide epidemics of obesity and physical inactivity.
- The combined prevalence of **elevated blood pressure and hypertension** in children is around **6%**, or 3% for each.
- The combined prevalence increases by nearly **five times**, to around **30%**, in adolescents who are **obese**.

Hypertension **Key facts**

- High blood pressure in childhood is correlated with higher blood pressure and risk of cardiovascular disease (CVD) in adulthood, and this relationship strengthens with age.
- Primary hypertension in children is associated with other risk factors for CVD, including hyperlipidemia and insulin resistance.
- Children also experience target organ damage from hypertension, including left ventricular hypertrophy and pathologic vascular changes (i.e., carotid intima-media thickness)

Hypertension **Key facts**

- Children should be screened for elevated blood pressure annually beginning at three years of age or at every visit if risk factors are present.
- In children younger than 13 years, elevated blood pressure is defined as blood pressure in the 90th percentile or higher for age, height, and sex, and hypertension is defined as blood pressure in the 95th percentile or higher.
- In adolescents 13 years and older, elevated blood pressure is defined as blood pressure of 120 to 129 mm Hg systolic and less than 80 mm Hg diastolic, and hypertension is defined as blood pressure of 130/80 mm Hg or higher.

Table 2. Predominant Risk Factors for Myocardial Infarction and Stroke Based on the INTERHEART and INTERSTROKE Studies^{30,31}

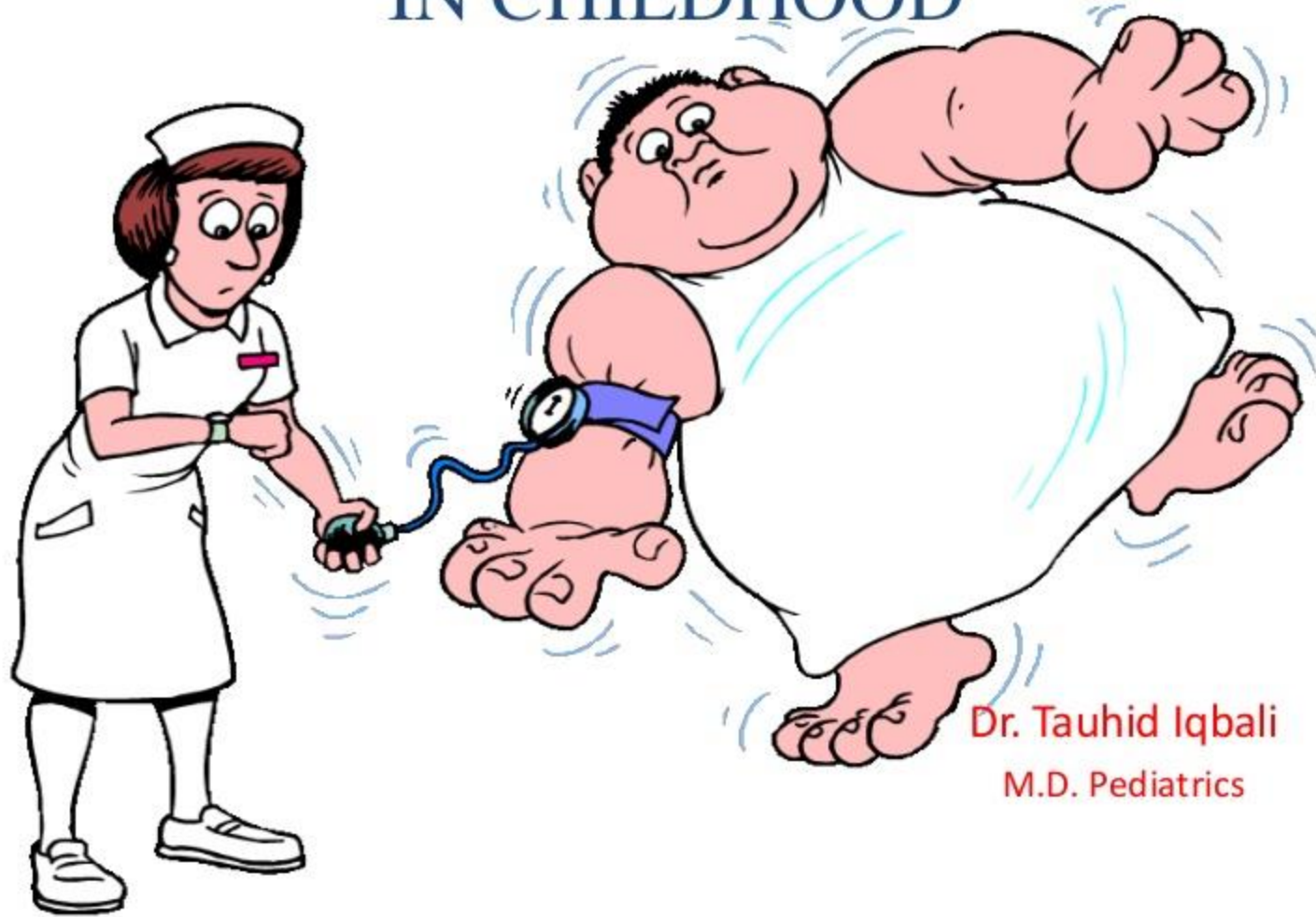
| | Myocardial Infarction | | | Stroke | | |
|----------------------------------|-----------------------|------------|------|--------|------------|------|
| | Rank | Odds Ratio | PAR | Rank | Odds Ratio | PAR |
| ApoB/ApoA1 ratio | 1 | 3.25 | 49.2 | 3 | 1.84 | 26.8 |
| Smoking | 2 | 2.87 | 35.7 | 7 | 1.67 | 12.4 |
| Psychosocial factors* | 3 | 2.67 | 32.5 | 6 | 2.20 | 17.4 |
| Abdominal obesity | 4 | 1.62 | 20.1 | 5 | 1.44 | 18.6 |
| Self-report of hypertension | 5 | 1.91 | 17.9 | 1 | 2.98 | 47.9 |
| Healthy diet† | 6 | 0.70 | 13.7 | 4 | 0.60 | 23.2 |
| Physical activity | 7 | 0.86 | 12.2 | 2 | 0.60 | 35.8 |
| Self-report of diabetes mellitus | 8 | 2.37 | 9.9 | 10 | 1.16 | 3.9 |
| Regular alcohol consumption | 9 | 0.91 | 6.7 | 9 | 2.09 | 5.8 |
| Cardiac causes | NA | NA | NA | 8 | 3.17 | 9.9 |

Apo indicates apolipoprotein; NA, not applicable; and PAR, population attributable risk.

*Only partly confirmed in prospective studies.

†Dietary measure in INTERHEART was daily fruit and vegetable consumption and in INTERSTROKE was measured using the modified Alternative Healthy Eating Index.

APPROACH TO HYPERTENSION IN CHILDHOOD



Dr. Tauhid Iqbali
M.D. Pediatrics

2017 American Academy of Pediatrics updated definitions for pediatric blood pressure categories

| | For children aged 1 to <13 years | For children aged ≥13 years |
|--------------------|--|--|
| Normal BP | Systolic and diastolic BP <90 th percentile | Systolic BP <120 and diastolic BP <80 mmHg |
| Elevated BP | Systolic and diastolic BP ≥90 th percentile to <95 th percentile, or 120/80 mmHg to <95 th percentile (whichever is lower) | Systolic BP 120 to 129 and diastolic BP <80 mmHg |
| Stage 1 HTN | Systolic and diastolic BP ≥95 th percentile to <95 th percentile+12 mmHg, or 130/80 to 139/89 mmHg (whichever is lower) | 130/80 to 139/89 mmHg |
| Stage 2 HTN | Systolic and diastolic BP ≥95 th percentile+12 mmHg, or ≥140/90 mmHg (whichever is lower) | ≥140/90 mmHg |

BP: blood pressure; HTN: hypertension.

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Blood pressure levels for boys by age and height percentile

| BP (percentile) | Systolic BP (mmHg) | | | | | | | Diastolic BP (mmHg) | | | | | | |
|----------------------------|--------------------------------------|------|------|------|------|------|------|--------------------------------------|------|------|------|------|------|------|
| | Height percentile or measured height | | | | | | | Height percentile or measured height | | | | | | |
| | 5% | 10% | 25% | 50% | 75% | 90% | 95% | 5% | 10% | 25% | 50% | 75% | 90% | 95% |
| 1 year | | | | | | | | | | | | | | |
| Height (in) | 30.4 | 30.8 | 31.6 | 32.4 | 33.3 | 34.1 | 34.6 | 30.4 | 30.8 | 31.6 | 32.4 | 33.3 | 34.1 | 34.6 |
| Height (cm) | 77.2 | 78.3 | 80.2 | 82.4 | 84.6 | 86.7 | 87.9 | 77.2 | 78.3 | 80.2 | 82.4 | 84.6 | 86.7 | 87.9 |
| 50 th | 85 | 85 | 86 | 86 | 87 | 88 | 88 | 40 | 40 | 40 | 41 | 41 | 42 | 42 |
| 90 th | 98 | 99 | 99 | 100 | 100 | 101 | 101 | 52 | 52 | 53 | 53 | 54 | 54 | 54 |
| 95 th | 102 | 102 | 103 | 103 | 104 | 105 | 105 | 54 | 54 | 55 | 55 | 56 | 57 | 57 |
| 95 th + 12 mmHg | 114 | 114 | 115 | 115 | 116 | 117 | 117 | 66 | 66 | 67 | 67 | 68 | 69 | 69 |
| 2 years | | | | | | | | | | | | | | |
| Height (in) | 33.9 | 34.4 | 35.3 | 36.3 | 37.3 | 38.2 | 38.8 | 33.9 | 34.4 | 35.3 | 36.3 | 37.3 | 38.2 | 38.8 |
| Height (cm) | 86.1 | 87.4 | 89.6 | 92.1 | 94.7 | 97.1 | 98.5 | 86.1 | 87.4 | 89.6 | 92.1 | 94.7 | 97.1 | 98.5 |
| 50 th | 87 | 87 | 88 | 89 | 89 | 90 | 91 | 43 | 43 | 44 | 44 | 45 | 46 | 46 |
| 90 th | 100 | 100 | 101 | 102 | 103 | 103 | 104 | 55 | 55 | 56 | 56 | 57 | 58 | 58 |
| 95 th | 104 | 105 | 105 | 106 | 107 | 107 | 108 | 57 | 58 | 58 | 59 | 60 | 61 | 61 |
| 95 th + 12 mmHg | 116 | 117 | 117 | 118 | 119 | 119 | 120 | 69 | 70 | 70 | 71 | 72 | 73 | 73 |

TABLE 6 Screening BP Values Requiring Further Evaluation

| Age, y | BP, mm Hg | | | |
|--------|-----------|-----|----------|-----|
| | Boys | | Girls | |
| | Systolic | DBP | Systolic | DBP |
| 1 | 98 | 52 | 98 | 54 |
| 2 | 100 | 55 | 101 | 58 |
| 3 | 101 | 58 | 102 | 60 |
| 4 | 102 | 60 | 103 | 62 |
| 5 | 103 | 63 | 104 | 64 |
| 6 | 105 | 66 | 105 | 67 |
| 7 | 106 | 68 | 106 | 68 |
| 8 | 107 | 69 | 107 | 69 |
| 9 | 107 | 70 | 108 | 71 |
| 10 | 108 | 72 | 109 | 72 |
| 11 | 110 | 74 | 111 | 74 |
| 12 | 113 | 75 | 114 | 75 |
| ≥13 | 120 | 80 | 120 | 80 |

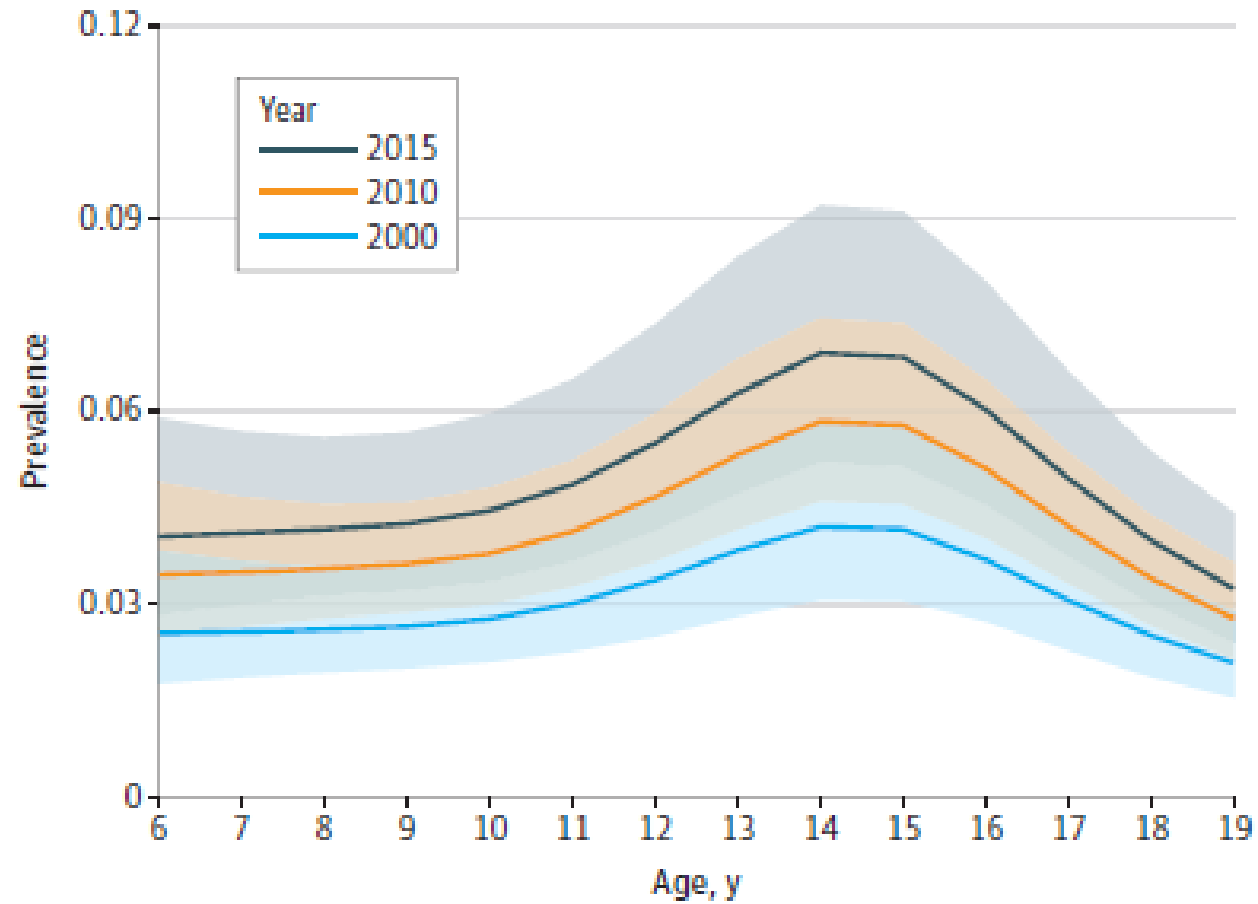
• Simplified Blood Pressure Table

- Full BP tables are complicated○Leads to under-recognition of childhood HTN
- Simplified BP table created for use in initial screening of BP values○Based on 90th percentile BP values for children at 5th height percentile

Global prevalence of hypertension in children a systematic review and meta-analysis. peige song, et al

- A total of 47 articles were included in the meta-analysis.
- The pooled prevalence was 4.00% (95% CI, 3.29%-4.78%) for hypertension,
- 9.67% (95% CI, 7.26%-12.38%) for prehypertension,
- 4.00% (95% CI, 2.10%-6.48%) for stage 1 hypertension, and
- 0.95% (95% CI, 0.48%-1.57%) for stage 2 hypertension in children 19 years and younger.
- A trend of increasing prevalence of childhood hypertension was observed during the past 2 decades, with a relative increasing rate of 75% to 79% from 2000 to 2015.
- In 2015, the prevalence of hypertension ranged from 4.32% (95% CI, 2.79%-6.63%) among children aged 6 years to 3.28% (95% CI, 2.25%-4.77%) among those aged 19 years and peaked at 7.89% (95% CI, 5.75%-10.75%) among those aged 14 years

Figure 2. Age-Specific Prevalence of Childhood Hypertension in 2000, 2010, and 2015



Childhood hypertension was based on blood pressure measured by mercury sphygmomanometer. Shaded areas indicate 95% CIs.




Risk factors

- Salt intake. Processed and convenience foods tend to be very high in salt.
- Obesity. Childhood obesity increases the risk of childhood hypertension.
- Low birth weight. This seems to be a particular risk factor in patients who subsequently have a high BMI.
- Family history of hypertension or cardiovascular disease.
- Male gender.
- Maternal smoking during pregnancy.



Original Article

Obesity and underweight: Serious health problems in Iranian primary school children

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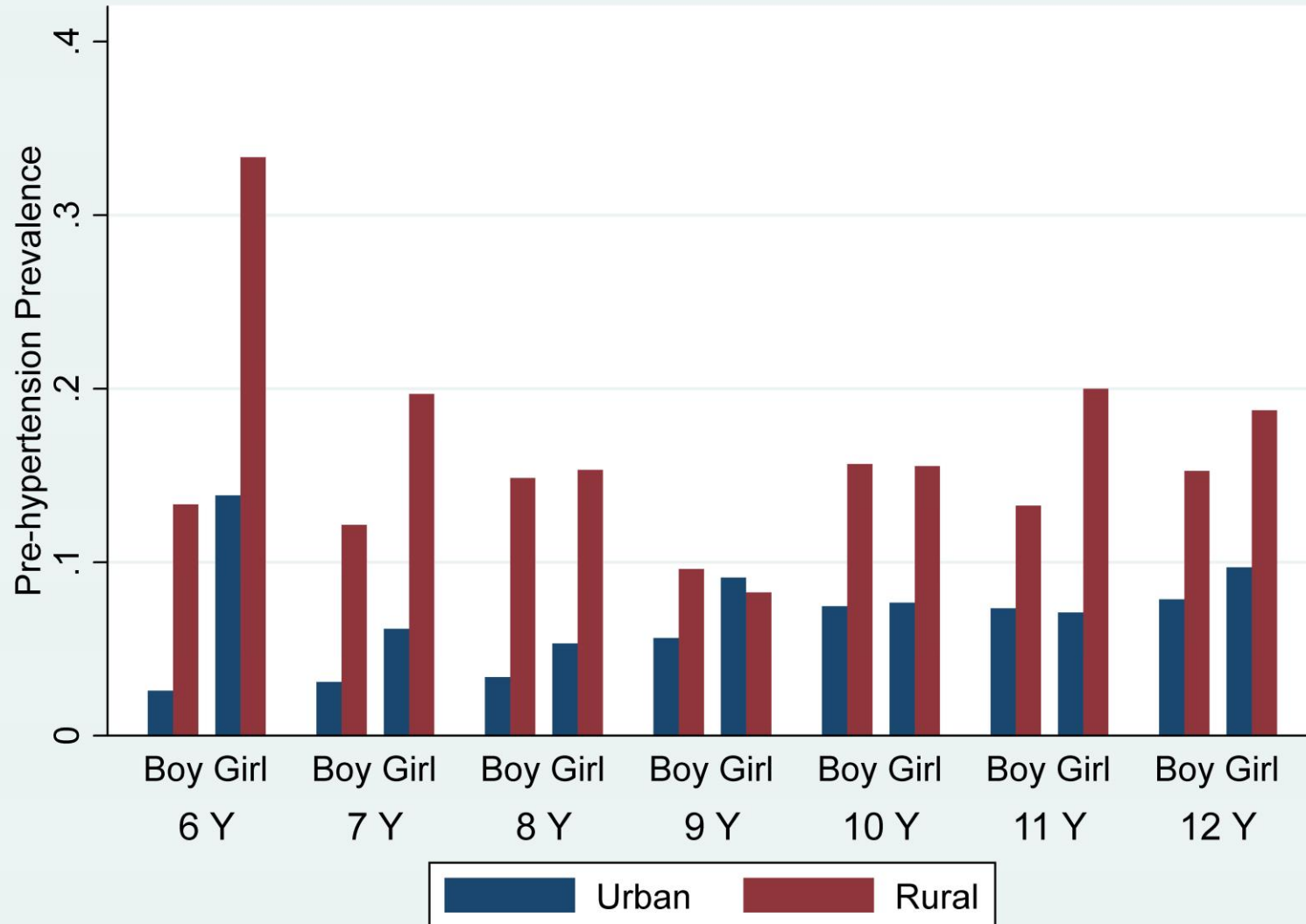
Abstract

Background: Childhood obesity is increasing around the world. Compared with developed countries, the rate of increase is 30% higher in developing countries, where the monitoring of obesity and overweight is essential. This study investigated the prevalence of obesity, overweight, thinness, and stunting in primary school students in Shahroud, Iran.

Methods: A total of 5,620 primary students were enrolled during 2015. In rural areas all students were invited to participate, while cluster sampling was used in urban areas and 200 classrooms were selected randomly as clusters. Height, weight and body mass index Z-scores for age (HAZ, WAZ and BAZ) were calculated based on World Health Organization standard. The mean indices and prevalence of obesity, overweight, thinness, and stunting were calculated by education level, gender, and place of residence. Prevalence of obesity and overweight was estimated also by international obesity task force definition.

Results: The mean WAZ, HAZ, and BAZ were 0.050 ± 1.25 , 0.005 ± 0.98 , and 0.076 ± 1.35 , respectively. These indices in rural areas were significantly lower than those in urban areas ($P < 0.001$). Overall, 25.7% of children in urban areas (95%CI: 24.1–27.4) and 14.8% in rural areas (95%CI: 12.3–17.3) were overweight or obese, and 5.1% of rural girls (95%CI: 3.1–7.0) were stunted.

Prevalence of prehypertension and hypertension and its risk factors in Iranian school children: a population-based study. Ebrahimi et al



The prevalence of prehypertension was **7.44%** and the prevalence of hypertension was **6.82%**.

Prevalence of prehypertension and hypertension and its risk factors in Iranian school children: a population-based study. Ebrahimi et al

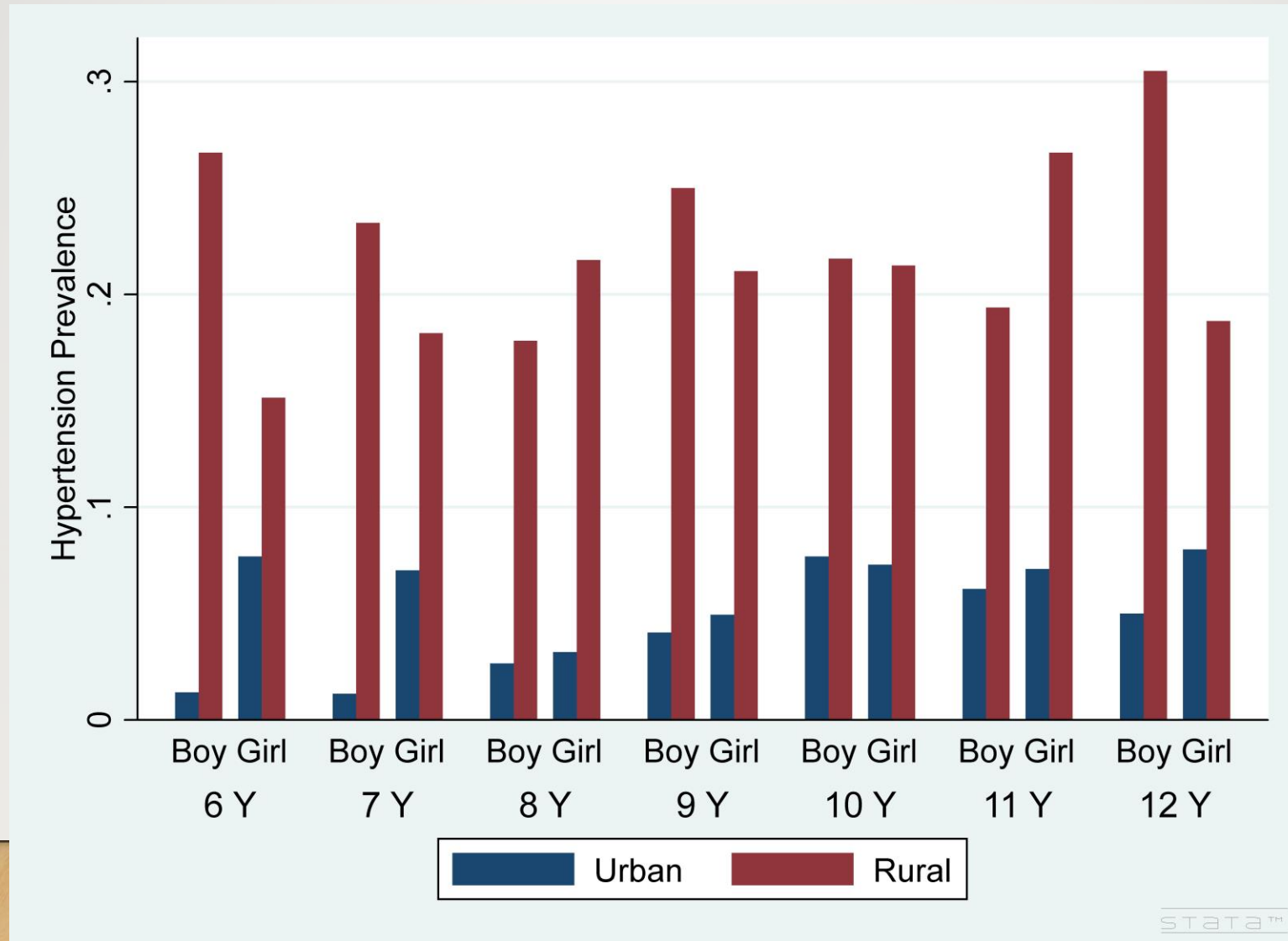
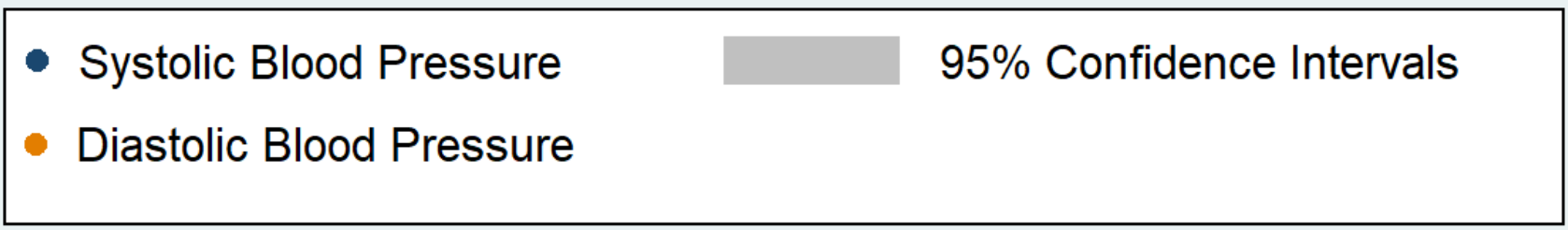
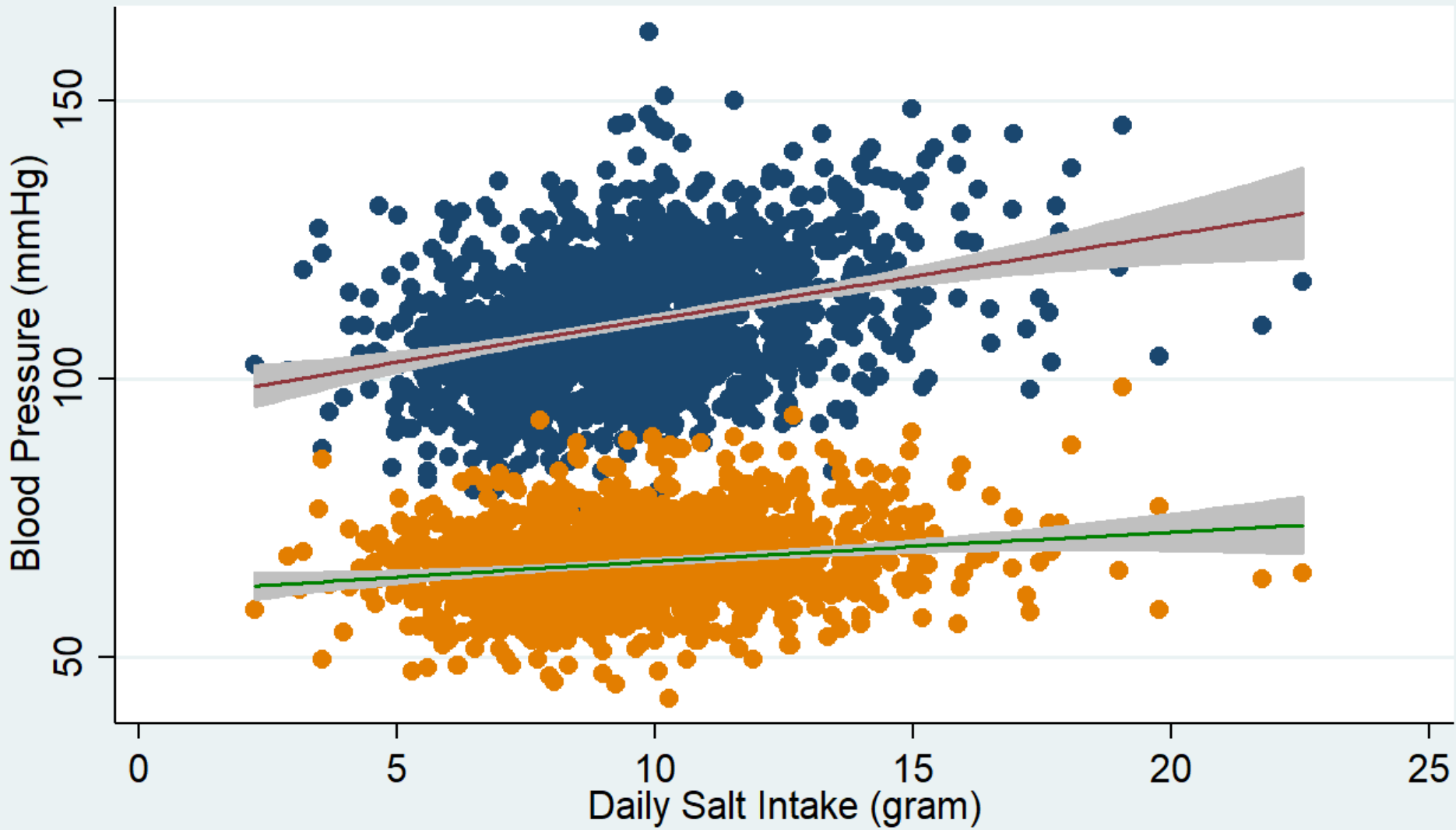


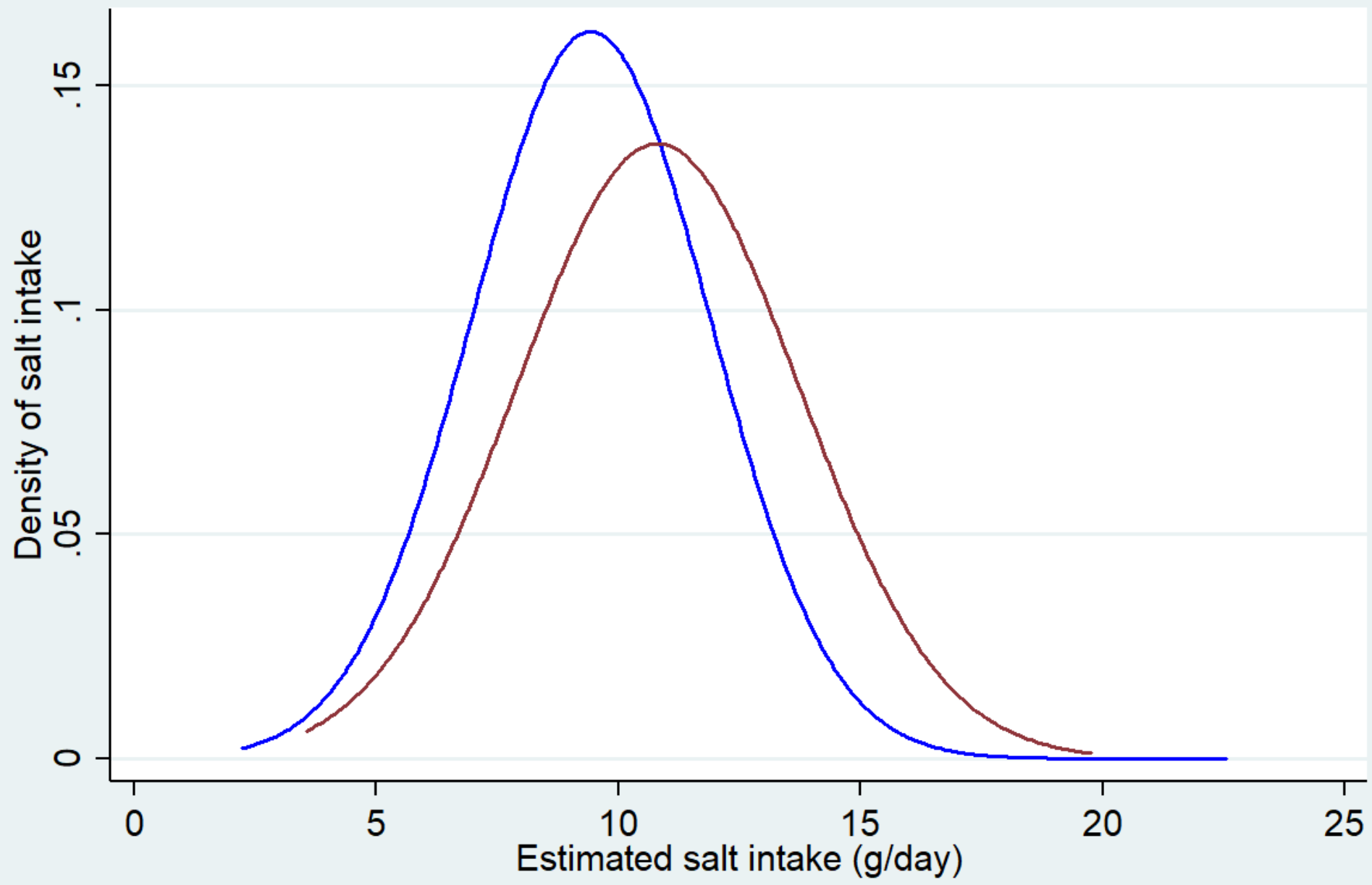
TABLE 4. The role of different independent variables on prehypertension and hypertension of children according to multiple multinomial logistic regression, Shahroud, Iran, 2015

| Independent variables | Prehypertension | | Hypertension | | |
|-----------------------|------------------------------|------------------|------------------------------|------------------|--------|
| | Relative risk ratio (95% CI) | P value | Relative risk ratio (95% CI) | P value | |
| Sex | Boy | Reference | Reference | | |
| | Girl | 1.43 (1.11–1.83) | 0.005 | 1.31 (0.95–1.80) | 0.094 |
| BMI | | 1.17 (1.13–1.20) | <0.001 | 1.22 (1.18–1.26) | <0.001 |
| Region | Urban | Reference | Reference | | |
| | Rural | 3.71 (2.80–4.93) | <0.001 | 6.64 (4.69–9.39) | <0.001 |
| Age (groups) | 6 | Reference | Reference | | |
| | 7 | 0.53 (0.33–0.87) | 0.013 | 0.88 (0.43–1.79) | 0.721 |
| | 8 | 0.45 (0.25–0.78) | 0.005 | 0.59 (0.26–1.36) | 0.217 |
| | 9 | 0.59 (0.34–1.03) | 0.063 | 0.75 (0.33–1.70) | 0.496 |
| | 10 | 0.64 (0.36–1.15) | 0.138 | 1.00 (0.42–2.36) | 0.997 |
| | 11 | 0.53 (0.29–0.96) | 0.037 | 0.78 (0.34–1.79) | 0.565 |
| | 12 | 0.56 (0.31–1.00) | 0.052 | 0.67 (0.29–1.57) | 0.359 |
| Economic status | High | Reference | Reference | | |
| | Moderate | 0.95 (0.73–1.25) | 0.744 | 1.69 (1.19–2.39) | 0.003 |
| | Low | 1.11 (0.84–1.48) | 0.462 | 1.89 (1.29–2.76) | 0.001 |

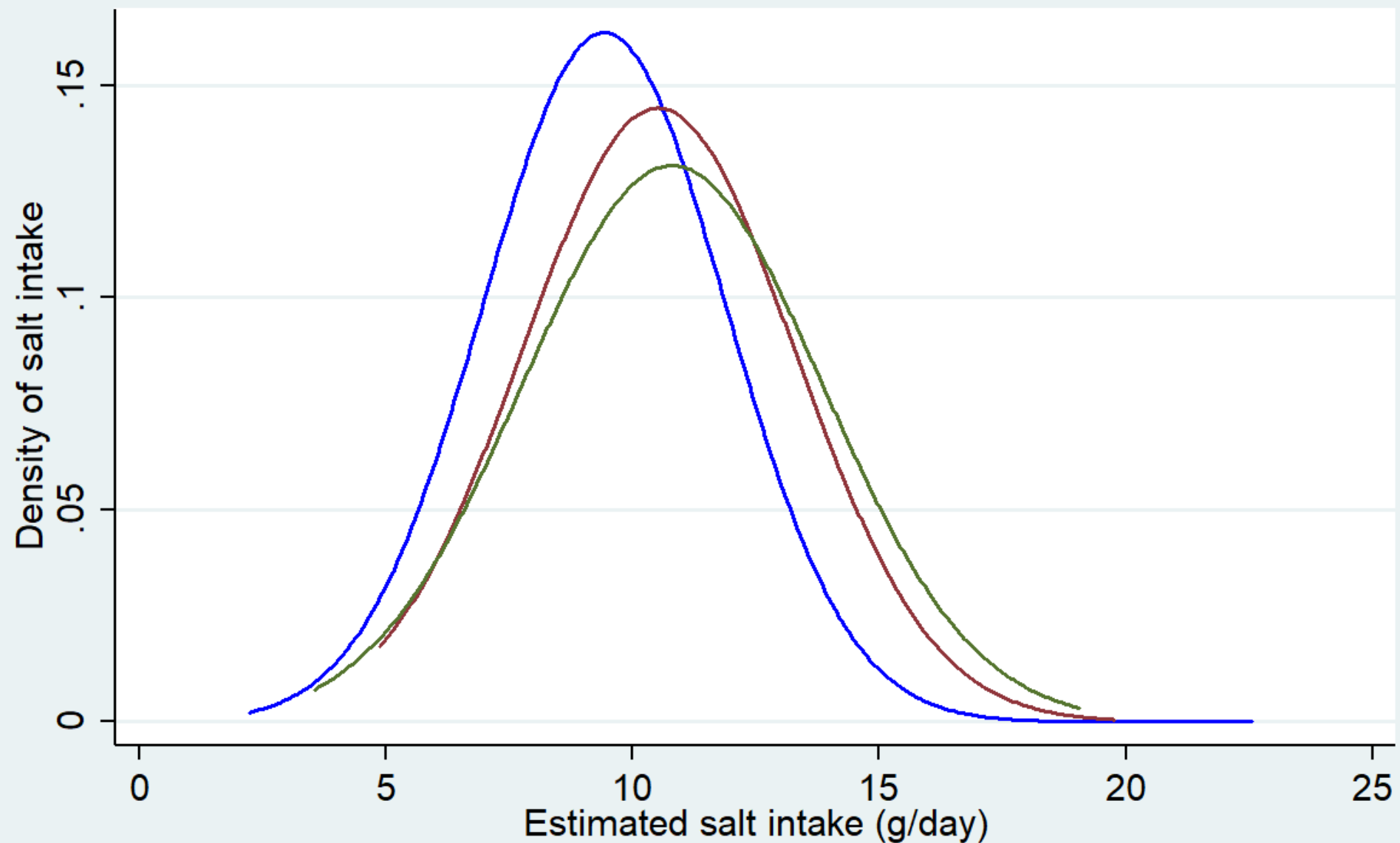
Salt intake and blood pressure in Iranian children and adolescents: a population-based study. Emamian et al

- Among 1455 participants mean daily salt intake was 9.7 ± 2.6 g (95% CI 9.5–9.8).
- The mean salt consumption in rural areas [10.8 (95% CI 10.4–11.2)] was higher than urban areas [9.4 (95% CI 9.3–9.6)], in people with hypertension [10.8 (95% CI 10.3–11.3)] was more than people with normal blood pressure [9.4 (95% CI 9.3–9.6)], and in boys [9.8 (95% CI 9.7–10.0)] was more than girls [9.3 (95% CI 9.1–9.6)].
- Higher age, BMI z-score, male sex and rural life, were associated with increased daily salt intake. Increased salt intake was associated with increased systolic and diastolic blood pressure.





Urban Rural





Thanks!
Any question?