

主論文の要旨

**Age and sex differences in factors associated with
hypertension among an urban poor population
in Bangladesh**

（ バングラデシュ貧困層居住地域住民における
高血圧関連要因の性と年齢による差異 ）

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【Introduction】

The prevalence of hypertension in men is known to be higher than that in women up to 40 years of age; however, such sex difference decreases and even reverses when women enter their 50s or the age of menopause. Risk factors such as abdominal obesity and dyslipidemia were reported to be associated with hypertension more prominently in younger than older age groups. However, the difference by age groups in the associations of various potential risk factors with hypertension has not yet been studied in Bangladesh.

This study aims to explore the difference in factors associated with hypertension between younger and older age groups of men and women in an urban poor community in Bangladesh.

【Methods】

Data source

We analyzed the data of 2009 individuals (1,008 men and 1,001 women) obtained from a cross-sectional survey conducted between October 2015 and April 2016, targeting adults aged 18 to 64 years in an urban slum community in Dhaka, Bangladesh.

Outcome

Hypertension was defined as systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg or taking any antihypertensive medication.

Statistical analyses

All analyses were stratified by sex and two age groups (18-44 and 45-64 years). We chose 45 years of age as the cutoff for the stratification according to previous studies on the median age of menopause of women in Bangladesh. The associations of age (continuous) and the following categorical variables with hypertension were assessed using multivariable logistic regression and expressed as odds ratios (ORs) and 95% confidence intervals (95% CIs): years of education, marital status, tobacco smoking, smokeless tobacco use, physical activity, Hemoglobin A1c (HbA1c), triglycerides, low-density lipoprotein (LDL), and high-density lipoprotein (HDL) cholesterol, body mass index (BMI) and waist circumference. Marital status was not included in older men as only two men were single. Tobacco smoking was not included in women as there were no smoking women. We used the lowest category as the reference for all the variables. Statistical significance of the interactions terms of age groups with each categorical variable were tested in a multivariable model that simultaneously entered these terms by likelihood ratio test.

Sensitivity analyses were performed after excluding 137 individuals (42 men and 95 women) who reported taking medication for hypertension. In all the analyses, P-values

of < 0.05 were considered as to indicate statistical significance.

【Results】

The prevalence of hypertension defined as blood pressure $\geq 140/90$ mmHg or on treatment was 13.0% in men and 14.6% in women of the younger age groups; and 35.6 % in men and 38.7 % in women of the older age groups. The multivariable-adjusted ORs (95% CIs) of BMI ≥ 27.5 kg/m² compared to the category with < 25 kg/m² were 1.48 (0.63-3.47) and 1.82 (0.48-6.84) in men and 1.99 (1.00-4.00) and 1.65 (0.65-4.20) in women, respectively (Figures 1 and 2). The multivariable-adjusted ORs of the waist circumference category ≥ 90 cm compared to < 80 cm in younger and older men were 5.12 (2.19-11.94) and 2.29 (0.83-6.34), respectively. And the multivariable-adjusted ORs of the ≥ 90 cm category compared to < 80 cm in younger and older women were 1.88 (0.88-4.03) and 1.20 (0.48-3.03), respectively.

HbA1c $\geq 6.5\%$ was associated with hypertension in both younger and older women (multivariable-adjusted ORs and 95% CIs: 2.11 (1.20-3.69) and 2.71 (1.31-5.60), respectively). LDL cholesterol ≥ 130 mg/dl was associated with hypertension in younger men and in younger women (2.20 (1.14-4.26) and 2.49 (1.34-4.61), respectively). Triglycerides ≥ 200 mg/dl significantly associated with hypertension only in younger women (multivariable-adjusted ORs and 95% CIs: 1.82 (1.06-3.11)). Physical activity $\geq 3,000$ metabolic equivalent thermogenesis (METs) per week was inversely associated with hypertension in older men not in younger men (multivariable-adjusted OR (95% CI): 0.39 (0.16-0.89) and 1.36 (0.72-2.56), respectively) (physical activity METs per week -age interaction $p = 0.008$ in men).

Similar results were observed in the sensitivity analysis that excluded subjects taking antihypertensive medication.

【Discussion】

We explored the associations of sociodemographic, lifestyle, anthropometric and other cardiovascular risk factors with hypertension in younger and older men and women separately in an urban poor community in Bangladesh. One of our findings that high waist circumference was associated with hypertension in younger men and high BMI was associated with hypertension in younger women in multivariable model may suggest that inter-individual variations of one compared to the other would be a better indicator of obesity in relation to hypertension risk. However, neither high waist circumference nor high BMI were statistically significantly associated with hypertension in older men and women. This might be partly due to generally increased arterial stiffness regardless of the degree of obesity in the older age group. Weaker associations between obesity and hypertension in older people compared to younger group have been reported from South Asian countries, Japan, and the United States.

Dyslipidemia (LDL cholesterol in younger men and LDL cholesterol and triglycerides in younger women) were associated with hypertension in younger men and women. The finding is consistent with a report among Japanese men under 40 years old and a hospital-based study in Bangladesh. Dyslipidemia is reported to impair endothelial function, which leads to a disruption of nitric oxide production and blood pressure regulation.

Raised blood glucose measured by HbA1c $\geq 6.5\%$ was associated with hypertension in both younger and older women. Raised blood glucose is known to increase the risk of hypertension, as it increases circulating blood volume, advances arteriosclerosis, and raises the tone of sympathetic nerve systems through increased insulin secretion as a reaction to the increased insulin resistance. Our findings showed that the association between raised blood glucose and hypertension was more prominent in the older age group than the younger age group, perhaps because of a longer duration of raised blood glucose in the older age group. We found that HbA1c was associated with hypertension only in women after including various factors in multivariable model. It was reported that the risks of endothelial dysfunction, hypertension, and the increase of insulin resistance are higher in women with raised blood glucose than men with the similar condition.

There was an inverse association between physical activity and hypertension only in older men. It might have been caused by a fact that younger men in this urban poor community were likely to be involved in vigorous physical work such as *riksha* drivers, which would not necessarily contribute to decreasing blood pressure. The association between physical activity and hypertension in women was not identified due to the small sample size of women with high levels of physical activity.

The strength of our study is that we, for the first time, examined the association of HbA1c and blood lipids with hypertension stratified by sex and age groups among an urban poor population in Bangladesh, who were at high risk of noncommunicable diseases (NCDs). This study has a few limitations. First, due to the nature of a cross-sectional study, causal relationships could not be identified. Second, residual confounding by diet, alcohol drinking, or other unknown factors cannot be excluded. Third, information regarding the age of menopause was not available.

【Conclusion】

In conclusion, this study found that waist circumference in younger men and BMI in younger women were independently positively associated with hypertension; LDL cholesterol in younger men and LDL cholesterol and triglycerides in younger women were positively associated with hypertension; HbA1c was positively associated with hypertension in women; and physical activity was inversely associated with hypertension in men of the older age group. This suggests that public health interventions to prevent hypertension may need different approaches according to sex and age groups in the urban poor population in Bangladesh.