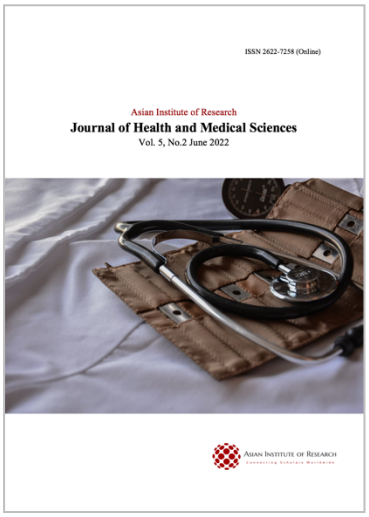

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Prevalence, Risk Factors, Awareness, and Control of Hypertension: A Cross-Sectional Study in an Urban Slum Area of Bangladesh

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Abstract
Background: Although hypertension was formerly thought to be a disease in affluent countries, recent data suggest that low- and middle-income countries account for three-quarters of the worldwide hypertension burden. Several studies have shown a high prevalence of HTN in Bangladesh, while data on urban slum areas are scarce. Objective: The purpose of this study was to assess the prevalence, risk factors, awareness, treatment, and control of hypertension in an urban slum area of Bangladesh. Methods: This cross-sectional study included 602 adults aged 18 years and above living in slum areas of Donia union at Kodomtali Thana, Dhaka, from September to October 2018 by simple random sampling. Multivariate logistic regression analysis was performed to predict the risk factors for hypertension. Results: A quarter of the urban slum dwellers were suffering from hypertension. Higher aged groups, 31 to 45 years [adjusted odds ratio (AOR): 2.56; 95% confidence interval (CI): 1.54-4.27] and 46 and above years [AOR: 5.13; 95% CI: 2.68-9.82], family history of hypertension [AOR: 1.93; 95% CI: 1.24-2.99], and obesity [AOR: 2.86; 95% CI: 1.34-6.12] were found to be the significant risk factors of hypertension. Middle socio-economic status [AOR: 0.56; 95% CI: 0.34-0.93] and underweight [AOR: 0.36; 95% CI: 0.15-0.83] showed negative association with hypertension. Among the hypertensive participants, 20.6% were aware of their hypertension, 16.8% were on antihypertensive treatment, and 7.7% had their blood pressure controlled. Conclusion: A high prevalence of hypertension associated with poor awareness and control in an urban slum community needs government initiatives for prevention.

Keywords: Bangladesh, BMI, Hypertension, Urban Dwellers, WH Ratio

1. Introduction

Cardiovascular disease (CVD) accounts for one-third of total global death annually (Schutte, 2021). According to the Global Burden of Disease (GBD) Study, roughly 18.6 million people died of CVD in 2019, representing a 17.1% increase over the previous decade (Roth et al., 2020). This increased prevalence ranks hypertension (HTN) as the top modifiable risk factor for global CVD burden (Roth et al., 2020).

HTN directly contributes to the pathogenesis of most of the CVDs, such as stroke, coronary artery disease, heart failure, etc., and eventually causes premature mortality and disability (Mills et al., 2016). Being undiagnosed due to incomprehensive symptoms of early-stage HTN and non-compliance to the treatment, many people have their blood pressure (BP) uncontrolled over a long period which causes further complications like kidney failure, dementia, and cognitive decline (Mills et al., 2016; Tzourio, 2007).

HTN was once stereotyped as the problem of affluent society due to its high prevalence in developed countries. However, contrariety in improving awareness, treatment, and control over the past few decades has shifted the scenario where three-quarters of the global HTN cases belonged to low- and middle-income countries (LMICs) (Mills et al., 2016). In addition to established risk factors such as unhealthy diet, physical inactivity, tobacco and alcohol use, and obesity, emerging risk factors such as environmental pollution, rapid urbanization, and a loss of green space boost the rising prevalence of HTN (Schutte, 2021).

Because of demographic transition, aging, and urbanization, together with an unhealthy lifestyle, LMICs had a greater prevalence of HTN, estimated at 32.3% in 2015, compared to a global prevalence of 22% (Sarki, 2015; Zhou et al., 2017). CVD-related mortality is rapidly increasing in these underprivileged areas due to a lack of HTN awareness, medication, and control among the affected population (Mills et al., 2016). In the South Asian setting, the pooled prevalence of HTN in India, Pakistan, Bangladesh, and Nepal was reported 31.5%, with a higher incidence in urban (30-56%) than in rural areas (11-43%) (Gupta et al., 2017).

Bangladesh is highly vulnerable to HTN-related disease burden due to socio-demographic factors. Several studies based on diverse socio-demographic contexts in Bangladesh have found varying HTN prevalence ranging from 1.1% to 75%, with a weighted pooled prevalence of 20% and a higher trend in urban areas (M. Z. I. Chowdhury et al., 2020).

Approximately 14 million people live in Dhaka, where more than four million live in about 5000 slum areas (United Nations Children's Fund, 2015). Slum inhabitants are vulnerable to unhealthy lifestyles and related diseases due to poor socio-environmental conditions and poverty, while access to basic healthcare services is also limited.

The few studies so far conducted in Bangladesh only highlighted the prevalence and risk factors of HTN. Thus, this study aimed to evaluate the prevalence, risk factors, awareness, treatment, and control of HTN in urban slum areas of Bangladesh.

2. Methods

2.1. Study settings

This cross-sectional study was conducted in the slum areas of Dania Union (the smallest administrative unit) under Kadamtali Thana (sub-district) of Dhaka, the capital of Bangladesh, from September to October 2018. The land area of this union is 3.32 sq. km and has approximately 261,000 populations (Banglapedia. Kadamtali Thana, 2021). Adults aged 18 years and above living in this area were the targeted population.

2.2. Sampling technique and sample

Sampled households were chosen from a list of pre-prepared slum households using simple random sampling. A lottery method was used to select an adult from each household. The sample size was determined considering the prevalence of HTN as 26.4% (Chowdhury, 2016), 3.5% error, and 10% non-response rate. A total of 602 were enrolled, with a drop-out rate of 10%.

2.3. Data collection methods

Respondent's age, sex (male/female), educational attainment, socio-economic status (SES) (based on wealth index [WI]), smoking habit (non-smoker, ever smoker), extra salt intake history (every day, sometimes, never), smokeless tobacco consumption (no, yes), fruit consumption (low consumption: <four servings or two cups per day, adequate consumption), vegetable consumption (low consumption: < five servings or two and a half cups per day, adequate consumption), waist-hip ratio (WHR), body mass index (BMI), and HTN (no, yes) were collected in a semi-structured questionnaire. In addition, history of smoking and smokeless tobacco consumption (tobacco leaf, gul, noshi, snuff, and zarda) were taken and categorized as tobacco user (current and ever smoker) and non-tobacco user. Household assets data such as a table, chair, watch, computer, energy supply, refrigerator, television, radio, mobile phone, bicycle, and air conditioner were collected to construct WI.

Weight, height, waist, and hip circumference measurements; BMI and WHR calculation; and BP recording and HTN diagnosis were performed using standardized methods and guidelines (Olack et al., 2015). Each participant's weight was measured in kilograms by setting a digital weighing machine on a flat surface, and their height was measured in centimeters using a measuring tape while they were barefooted and heavy clothing, if any, was removed. BMI was calculated as weight in kilograms divided by height in meters squared. Overweight and obesity were defined as BMI $\geq$ 25.0 – 29.9 kg/m2 and BMI $\geq$ 30 kg/m2, respectively. The waist circumference was measured to the nearest 0.1 cm by putting a measuring tape at the midpoint between the lower margin of the last rib and the tip of the iliac crest at the end of expiration. The hip circumference was measured at the widest part of the buttock with a tape parallel to the floor. WHR was calculated, and WHR $\geq$0.90 in males and $\geq$0.80 in females were considered as abdominal obesity.

BP was recorded three times at 5 minutes intervals in an upright sitting position in the right arm, using a digital BP measuring machine (OMRON, Model HEM-7120). The average of the last two readings was used for analysis. Hypertensive participants were defined as those with systolic blood pressure (SBP) equal to or more than 140 mm of Hg and/or diastolic blood pressure (DBP) equal to or more than 90 mm of Hg or those who were on antihypertensive medication.

2.4. Statistical analysis

Descriptive analysis was performed for the socio-demographic and other predictive factors. For continuous variables, mean and standard deviation (SD) were calculated. WI was generated using household assets. In this regard, the first factor of the principal component analysis, as described by Filmer and Pritchett, was used to determine SES (Filmer & Pritchett, 2001). Chi-square statistics were used to compare categorical variables, where multivariate logistic regression analysis was performed to examine the risk factors (expressed in adjusted odd ratio, [AOR] with 95% confidence interval, [CI]) of HTN. Participant's occupation was not included in the adjusted analysis due to collinearity. Analyses were performed using the Statistical Package for Social Sciences (SPSS) version 25.0. A P-value less than .05 was considered statistically significant.

2.5. Ethical consideration

Ethical permission was obtained from the Institutional Review Board of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka (Memo no. 2017/7389) and followed the ethical code of the Declaration of Helsinki.

3. Results

3.1. Participants

Among the participants, three-fourths were female. The participants' mean (SD) age was 34.07 (12.43) years, ranging from 18 to 81 years. Approximately half of the participants were young adults (up to 30 years old), while 17% were aged above 45 years. About 60% of participants had normal BMI. Most of the participants consumed raw salt every day (74.4%), had adequate daily vegetable consumption (64%), and did not use tobacco products (74.8%). One-third of the participants had a family history of HTN, while abdominal obesity was 63.4%.

Table 1: Prevalence of hypertension in several categories, along with risk factors

Characteristics	Percentage of the total sample (N=602)	Hypertension n (%)	AOR [95% CI] [a]
Gender			
Male	22.9	40 (29.0)	1 (Ref.)
Female	77.1	115 (24.8)	0.87 (0.41 – 1.82)
Age group			
Up to 30	48.3	45 (15.5)	1 (Ref.)
31 – 45	34.2	64 (31.1)	2.48 (1.49 – 4.14) ***
46 and above	17.4	46 (43.8)	5.24 (2.55 – 10.77) ***
Educational attainment			
Non-formal education	42.7	76 (29.6)	1 (Ref.)
Up to Grade V	31.2	48 (25.5)	1.24 (0.73 – 2.10)
Grade VI to X	23.4	26 (18.4)	0.68 (0.36 – 1.26)
Grade XI and above	2.7	5 (31.2)	1.12 (0.30 - 4.17)
Occupation			
Service holder	2.3	1 (7.1)	-
Business	7.6	17 (37.0)	-
Labor	20.8	27 (21.6)	-
Housewives	53.3	85 (26.5)	-
Unemployed	6.5	12 (30.8)	-
Others	9.5	13 (22.8)	-
Socio-economic status			
Lower	33.4	58 (28.9)	1 (Ref.)
Middle	36.7	43 (19.5)	0.53 (0.32 – 0.86) *
Upper	29.9	54 (30.0)	0.95 (0.58 – 1.57)
Salt intake history			
Never	11.6	17 (24.3)	1 (Ref.)
Everyday	74.4	113 (25.2)	1.10 (0.57 – 2.14)
Sometimes	14.0	25 (29.8)	1.28 (0.56 – 2.90)
Use of tobacco products			
No	74.8	109 (24.2)	1 (Ref.)
Yes	25.2	46 (30.3)	0.94 (0.59 – 1.49)
Fruit consumption			
Proper consumption	11.0	18 (27.3)	1 (Ref.)
Less consumption	89.0	137 (25.6)	0.82 (0.44 – 1.54)
Vegetable consumption			
Proper consumption	64.1	100 (25.9)	1 (Ref.)
Less consumption	35.9	55 (25.5)	0.90 (0.59 – 1.36)
Smoking history			
Non-smoker	83.9	129 (25.5)	1 (Ref.)
Ever smoker	16.1	26 (26.8)	1.11 (0.46 – 2.65)

Family history of hypertension			
No	67.9	93 (22.7)	1 (Ref.)
Yes	32.1	62 (32.1)	1.84 (1.21 – 2.82) **
BMI			
Underweight	13.6	10 (12.2)	0.40 (0.18 – 0.85) *
Normal	58.8	86 (24.3)	1 (Ref.)
Overweight and obese	27.6	41 (32.0)	1.62 (1.05 – 2.53) *
WH ratio			
Normal (<.90 M, <.80 F)	36.4	43 (19.6)	1 (Ref.)
Abdominally obese (≥.90 M, ≥.80 F)	63.6	112 (29.2)	1.40 (0.87 – 2.27)

* *P* value< .05
** *P* value< .01
*** *P* value < .001
[a] AOR [95% CI] = adjusted odds ratio [95% confidence interval]
Nagelkerke R-square =0.22

3.2. Prevalence and risk factors of HTN

The overall prevalence of HTN in the study population was 25.7%. In bivariate analysis, the prevalence of HTN was significantly higher in older adults, people with a family history of HTN, high BMI, and people with abdominal obesity. After adjusting potential confounders, age, body weight, family history of HTN, and SES were significantly associated with HTN in the logistic regression model. Compared to those under 30 years of age, the risk of HTN was about 2.5 times higher in the age group 31 to 45 years (AOR= 2.48, 95% CI: 1.49–4.14) and 5 times higher in the age group >45 years (AOR = 5.24, 95% CI: 2.55–10.77). The risk of HTN was about double in people with a family history of HTN (AOR = 1.84, 95% CI: 1.21–2.82) and people with overweight and obesity (AOR = 1.62, 95% CI: 1.05–2.53). People of middle SES (AOR: 0.53; 95% CI: 0.32 – 0.86) and underweight (AOR: 0.40; 95% CI; 0.18 – 0.85) showed negative association with HTN.

3.3. Awareness, treatment, and control of HTN

Overall, 71.3% of the study participants mentioned that their BP was measured at least once in their lifetime. Females had their BP measured more (75.2%) compared to males (58.0%). Of the total 155 hypertensive participants, 20.6% were previously aware of their hypertensive condition, and the remaining 79.4% were unaware before the survey. Around 17% of hypertensive participants were on antihypertensive medication prescribed by a registered physician, and 7.7% had their BP controlled.

Table 2: Prevalence, awareness, treatment, and control of hypertension

	Sample (N)	Number (%)	95% CI
Prevalence	602	155 (25.7)	22.3-29.4
Awareness	155	32 (20.6)	14.6-27.9
Treatment	155	26 (16.8)	11.3-23.6
Control	155	12 (7.7)	4.1-13.1

4. Discussion

According to our findings, approximately one out of every four persons aged 18 years and above is hypertensive. The overall prevalence of HTN in this study (25.7%) is higher than that of similar populations in Maharashtra (15.15%) and Bangalore city (21.5%) in India (Bendhari et al., 2016; Ramani & Suresh, 2020). However, the prevalence is considerably lower than that of the population from Kolkata, India (42%), Lagos, Nigeria (38.2%), and Cairo, Egypt (31.2%) (Banerjee et al., 2016; Daniel et al., 2013; Gadallah et al., 2018). These differences can

be ascribed to methodological variations, such as participant selection, age group, sex distribution, and geographical differences.

Nearly a third of the population had never had their BP checked, and 80% of the hypertensive population had gone unnoticed until this study, indicating a low level of HTN awareness. In a study of the rural Bangladeshi population, Islam et al. found a similar finding, estimating 82% of undiagnosed HTN (Islam et al., 2016). Furthermore, undiagnosed HTN was prevalent in 60% of the population in Bangladesh, according to a nationwide survey (Ahmed et al., 2019), with a higher incidence among persons with poor SES and low education levels. These findings are relevant to ours since slum residents generally have low education and SES.

The overall treatment and control status among hypertensive participants in our study was poor, with estimates of 16.8% and 7.7%. However, according to a study of nationally representative data of 1.1 million adults from 44 LMICs, among hypertensive participants, 29.9% (28.6–31.3%) received treatment, and 10.3% (9.6–11.0%) achieved HTN control, estimated using sampling weights (Geldsetzer et al., 2019).

The low level of awareness of HTN, its treatment, and control among the hypertensive participants of our study can be related to some factors reported in previous studies, which are more prevalent among the urban poor than the general population. These include poor socio-economic status, illiteracy, unemployment, lack of understanding and acceptance of the disease, poor health-seeking behavior, less affordability and inaccessibility to healthcare services, transportation time to a medical facility, long waiting time, and monetary costs (Daniel et al., 2013; Uddin et al., 2014; Khan et al., 2016).

We found that age was the most important risk factor for HTN, consistent with other studies in similar conditions (Bendhari et al., 2016; Ramani & Suresh, 2020; Banerjee et al., 2016; Daniel et al., 2013; Gadallah et al., 2018). The prevalence of HTN increased with age by nearly two and three times, from 15.5% in the 30-year group to 31% in the 31-45-year group and 43.8% in the above 45-year group. Age is a major non-modifiable risk factor for HTN that is present in every community worldwide. Aging causes vascular resistance, which prolongs inflammation, increases cellular oxidative stress and causes endothelial dysfunction (Buford, 2016). The proportion of elderly people in Bangladesh is rapidly increasing due to the ongoing demographic transition (M. Islam, 2016). In this flow, approximately 45 million elderly people will reside in Bangladesh by 2050 (M. Islam, 2016)(25), resulting in many hypertensive and other chronic disease-prone populations. It emphasizes the critical importance of effective intervention measures that anticipate other modifiable risk factors.

In this study, a family history of HTN was identified as one of the major risk factors widely regarded as a traditional non-modifiable risk factor for HTN. According to family-based studies, 30–50% of the variance in BP readings may be heritable, which is supported by studies showing a link between HTN and the renin-angiotensin-aldosterone system-related genes (Patel et al., 2017; Civeira et al., 2008).

Obesity is a well-known modifiable risk factor for HTN-related adverse cardiovascular conditions (Roth et al., 2020). In our study, participants who were overweight or obese were about 1.6 times more hypertensive than those who had a normal BMI. This finding is comparable with studies from India, Nigeria, and Egypt in similar conditions (Ramani & Suresh, 2020; Daniel et al., 2013; Gadallah et al., 2018). Obesity and HTN are more common in those over 35 years among slum dwellers in Nigeria and Uganda due to a poor diet, sedentary lifestyle, and lack of physical activity (Daniel et al., 2013; Mayega et al., 2012). Obesity causes HTN by increasing sodium reabsorption in the kidneys, activating the renin-angiotensin system and the sympathetic nervous system, altering intrarenal physical forces, and impairing pressure natriuresis (Aronow, 2017).

In our study, the prevalence of HTN was nearly halved in the middle SES group compared to the high and low SES groups. In both developed and developing countries, socioeconomic status is associated with hypertension. However, the associations are not linear which may reflect broad adoption of unhealthy lifestyles like sedentarism and high-fat diets across various SES groups (Mendez et al., 2003). There are also alternative risk factors like early malnutrition or psychosocial stress that potentially increase HTN prevalence among low SES groups in LMICs (Schutte, 2021). Therefore, identifying behavioral and environmental factors contributing to HTN in various SES groups in developing countries is critical for strengthening preventive strategies.

Underweight participants had a four times lower trend of HTN than those who were overweight and obese. A nearly similar trend was reported in a study based on South Asian BMI cut-off points, which estimated four times and three times lower HTN in underweight people than in obese and overweight people in the Bangladeshi population, respectively (Hossain et al., 2019). Underweight people may have improved insulin sensitivity and reduced sympathetic nervous system activity due to decreased renin-angiotensin-aldosterone system activation, natriuresis, and lower plasma volume, explaining why they have a lower prevalence of HTN (Aronow, 2017).

4.1. Strengths and limitations of the study

The survey method used in this study was a strength as it allows cross-study and cross-regional comparison. The selection of one adult from each home reduced the likelihood of over-representation bias. The study, however, had several limitations. First, data were collected from a single area, so the result cannot be generalized. Second, as this study was cross-sectional in design, the temporal association between variables could not be established. Third, data on self-reported harmful habits like tobacco, alcohol, and drug could not reflect the true picture due to the societal norm of not disclosing these habits. Fourth, we interviewed adults only and who were available at the selected households during the daytime. During the day, males are out at the workplace, and females remain at home, resulting in more female participation in this study. Finally, assessing HTN in a single day, BP measurement may cause some cases with white-coat HTN and result in overestimation.

5. Conclusions

HTN in urban slums is a public health concern that affects at least one in every four adults aged 18 and older. Participants' age, family history of HTN, overweight and obesity are significant risk factors for HTN. Unfortunately, most hypertensive participants are undiagnosed, which is a challenge for HTN control among underprivileged communities in slum areas. This emphasizes the need for promoting HTN awareness and encouraging health-seeking behavior.

Authors' Contributions

IJ contributed to the conception and design of the study, acquired the data, and carried out the data analysis; SMS contributed to the conception, carried out the data analysis, and drafted the manuscript; AIA helped in data analysis and interpretation; MS, SM, MIIT, MTI, WWM, and MMHK were major contributors in writing the manuscript and revised the manuscript for important intellectual content; MAH contributed to the conception and supervision of the study, was a major contributor in writing the manuscript, and edited for submission. All the authors read, approved the manuscript, and consented to publish.

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Competing interest

The authors declare that they have no competing interests.

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References

Ahmed, S., Tariqujjaman, M., Rahman, M. A., Hasan, M. Z., & Hasan, M. M. (2019). Inequalities in the prevalence of undiagnosed hypertension among Bangladeshi adults: evidence from a nationwide survey. International journal for equity in health, 18(1), 33. doi: 10.1186/s12939-019-0930-5

Aronow W. S. (2017). Association of obesity with hypertension. Annals of translational medicine, 5(17), 350. https://doi.org/10.21037/atm.2017.06.69

Bendhari, M. L., Korade, R. S., & Haralkar, S. J. (2016). Study of prevalence and risk factors of hypertension in adults in an urban slum area of Western Maharashtra, India. [Prevalence, Risk factors, Urban slum]. 2016, 3(10), 5. doi: 10.18203/2394-6040.ijcmph20163366

Banerjee, S., Mukherjee, T. K., & Basu, S. (2016). Prevalence, awareness, and control of hypertension in the slums of Kolkata. Indian heart journal, 68(3), 286–294. doi: 10.1016/j.ihj.2015.09.029

Banglapedia. Kadamtali Thana. (2021). https://en.banglapedia.org/index.php/Kadamtali_Thana

Buford T. W. (2016). Hypertension and aging. Ageing research reviews, 26, 96–111. doi: 10.1016/j.arr.2016.01.007

Chowdhury, M. A. B., Uddin, M. J., Haque, M. R., & Ibrahimou, B. (2016). Hypertension among adults in Bangladesh: evidence from a national cross-sectional survey. BMC cardiovascular disorders, 16, 22-22. doi: 10.1186/s12872-016-0197-3

Chowdhury, M., Rahman, M., Akter, T., Akhter, T., Ahmed, A., Shovon, M. A., Farhana, Z., Chowdhury, N., & Turin, T. C. (2020). Hypertension prevalence and its trend in Bangladesh: evidence from a systematic review and meta-analysis. Clinical hypertension, 26, 10 doi: 10.1186/s40885-020-00143-1

Civeira, F., Recalde, D., García-Otín, A. L., & Cenarro, A. (2008). Genetic Factors of Cardiovascular Diseases. In H. K. Heggenhougen (Ed.), International Encyclopedia of Public Health (pp. 44-55). Oxford: Academic Press.

Daniel, O. J., Adejumo, O. A., Adejumo, E. N., Owolabi, R. S., & Braimoh, R. W. (2013). Prevalence of hypertension among urban slum dwellers in Lagos, Nigeria. Journal of urban health : bulletin of the New York Academy of Medicine, 90(6), 1016–1025. doi: 10.1007/s11524-013-9795-x

Filmer, D., & Pritchett, L. H. (2001). Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India. Demography, 38(1), 115–132. doi: 10.1353/dem.2001.0003

Gadallah, M., Megid, S. A., Mohsen, A., & Kandil, S. (2018). Hypertension and associated cardiovascular risk factors among urban slum dwellers in Egypt: a population-based survey. Eastern Mediterranean health journal = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit, 24(5), 435–442. doi: 10.26719/2018.24.5.435

Geldsetzer, P., Manne-Goehler, J., Marcus, M. E., Ebert, C., Zhumadilov, Z., Wesseh, C. S., Tsabedze, L., Supiyev, A., Sturua, L., Bahendeka, S. K., Sibai, A. M., Quesnel-Crooks, S., Norov, B., Mwangi, K. J., Mwalim, O., Wong-McClure, R., Mayige, M. T., Martins, J. S., Lunet, N., Labadarios, D., … Jaacks, L. M. (2019). The state of hypertension care in 44 low-income and middle-income countries: a cross-sectional study of nationally representative individual-level data from 1·1 million adults. Lancet (London, England), 394(10199), 652–662. doi: 10.1016/S0140-6736(19)30955-9

Gupta, R., Kaur, M., Islam, S., Mohan, V., Mony, P., Kumar, R., Kutty, V. R., Iqbal, R., Rahman, O., Deepa, M., Antony, J., Vijaykumar, K., Kazmi, K., Yusuf, R., Mohan, I., Panwar, R. B., Rangarajan, S., & Yusuf, S. (2017). Association of Household Wealth Index, Educational Status, and Social Capital with Hypertension Awareness, Treatment, and Control in South Asia. American journal of hypertension, 30(4), 373–381. doi: 10.1093/ajh/hpw169

Hossain, F. B., Adhikary, G., Chowdhury, A. B., & Shawon, M. (2019). Association between body mass index (BMI) and hypertension in south Asian population: evidence from nationally-representative surveys. Clinical hypertension, 25, 28. doi: 10.1186/s40885-019-0134-8

Islam, F. M., Bhuiyan, A., Chakrabarti, R., Rahman, M. A., Kanagasingam, Y., & Hiller, J. E. (2016). Undiagnosed hypertension in a rural district in Bangladesh: The Bangladesh Population-based Diabetes and Eye Study (BPDES). Journal of human hypertension, 30(4), 252–259. doi: 10.1038/jhh.2015.65

Islam, M. (2016). Demographic transition and the emerging windows of opportunities and challenges in Bangladesh. Journal of Population Research, 33. doi: 10.1007/s12546-016-9174-z

Khan, J. A. M., Ahmed, S., MacLennan, M., Sarker, A. R., Sultana, M., & Rahman, H. (2016). Benefit incidence analysis of healthcare in Bangladesh – equity matters for universal health coverage. Health Policy and Planning, 32(3), 359-365. doi: 10.1093/heapol/czw131

Mayega, R. W., Makumbi, F., Rutebemberwa, E., Peterson, S., Östenson, C. G., Tomson, G., & Guwatudde, D. (2012). Modifiable socio-behavioural factors associated with overweight and hypertension among persons aged 35 to 60 years in eastern Uganda. PloS one, 7(10), e47632. doi: 10.1371/journal.pone.0047632

Mendez, M. A., Cooper, R., Wilks, R., Luke, A., & Forrester, T. (2003). Income, education, and blood pressure in adults in Jamaica, a middle-income developing country. International journal of epidemiology, 32(3), 400–408. doi: 10.1093/ije/dyg083

Mills, K. T., Bundy, J. D., Kelly, T. N., Reed, J. E., Kearney, P. M., Reynolds, K., Chen, J., & He, J. (2016). Global Disparities of Hypertension Prevalence and Control: A Systematic Analysis of Population-Based Studies From 90 Countries. Circulation, 134(6), 441–450. doi: 10.1161/CIRCULATIONAHA.115.018912

NCD Risk Factor Collaboration (NCD-RisC) (2017). Worldwide trends in blood pressure from 1975 to 2015: A pooled analysis of 1479 population-based measurement studies with 19·1 million participants. Lancet (London, England), 389(10064), 37–55. doi: 10.1016/S0140-6736(16)31919-5

Olack, B., Wabwire-Mangen, F., Smeeth, L., Montgomery, J., Kiwanuka, N., & Breiman, R. (2015). Risk factors of hypertension among adults aged 35-64 years living in an urban slum Nairobi, Kenya. BMC Public Health, 15. doi: 10.1186/s12889-015-2610-8

Patel, R. S., Masi, S., & Taddei, S. (2017). Understanding the role of genetics in hypertension. European Heart Journal, 38(29), 2309-2312. doi: 10.1093/eurheartj/ehx273

Ramani, V. K., & Suresh, K. P. (2020). Prevalence of hypertension and diabetes morbidity among adults in a few urban slums of Bangalore city, determinants of its risk factors and opportunities for control - A cross-sectional study. J Family Med Prim Care, 9(7), 3264-3271. doi: 10.4103/jfmpc.jfmpc_234_20

Roth, G. A., Mensah, G. A., Johnson, C. O., Addolorato, G., Ammirati, E., Baddour, L. M., Barengo, N. C., Beaton, A. Z., Benjamin, E. J., Benziger, C. P., Bonny, A., Brauer, M., Brodmann, M., Cahill, T. J., Carapetis, J., Catapano, A. L., Chugh, S. S., Cooper, L. T., Coresh, J., Criqui, M., … GBD-NHLBI-JACC Global Burden of Cardiovascular Diseases Writing Group (2020). Global Burden of Cardiovascular Diseases and Risk Factors, 1990-2019: Update from the GBD 2019 Study. Journal of the American College of Cardiology, 76(25), 2982–3021. doi: 10.1016/j.jacc.2020.11.010

Sarki, A. M., Nduka, C. U., Stranges, S., Kandala, N.-B., & Uthman, O. A. (2015). Prevalence of Hypertension in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. Medicine, 94(50).

Schutte, A. E., Venkateshmurthy, N. S., Mohan, S., & Prabhakaran, D. (2021). Hypertension in Low- and Middle-Income Countries. Circulation Research, 128(7), 808-826. doi: doi:10.1161/CIRCRESAHA.120.318729

Tzourio, C. (2007). Hypertension, cognitive decline, and dementia: an epidemiological perspective. Dialogues Clin Neurosci, 9(1), 61-70. doi: 10.31887/DCNS.2007.9.1/ctzourio

Uddin, M. J., Alam, N., Koehlmoos, T. P., Sarma, H., Chowdhury, M. A., Alam, D. S., & Niessen, L. (2014). Consequences of hypertension and chronic obstructive pulmonary disease, healthcare-seeking behaviors of patients, and responses of the health system: a population-based cross-sectional study in Bangladesh. BMC Public Health, 14, 547. doi: 10.1186/1471-2458-14-547

United Nations Children's Fund (UNICEF). (2015). Analysis of the Situation of Children and Women in Bangladesh 2015. https://www.unicef.org/bangladesh/en/children-cities%C2%A0