

Association of socioeconomic status with diagnosis, treatment and control of hypertension in diabetic hypertensive individuals in Bangladesh: a population-based cross-sectional study

Mosieur Rahman¹, Syed H Emdadul², Md. Jahirul Islam³, Md. Golam Mostofa¹ and Khandakar ASM Saadat⁴

¹Department of Population Science and Human Resource Development, University of Rajshahi, Rajshahi 6205, Bangladesh

²UChicago Research Bangladesh, House 4, Road 2/B, Sector 4, Ultra-1230, Dhaka, Bangladesh

³Ministry of Health and Family Welfare, Bangladesh Secretariat, Dhaka 1000, Bangladesh

⁴Department of Medical Biology and Genetics, Gaziantep University, Turkey

Corresponding author: Mosieur Rahman. Email: swaponru_2000@yahoo.com

Summary

Objectives: This study aimed to examine if socioeconomic status could affect the likelihood of diagnosis, treatment and control of hypertension in diabetic hypertensive individuals.

Design: Cross-sectional nationally representative study.

Settings: Bangladesh.

Participants: This paper used data from the 2011 Bangladesh Demographic Health Survey. The analyses were based on the responses of 339 diabetes hypertensive individuals.

Main outcome measures: Diagnosis, treatment and control of hypertension.

Results: The age-adjusted prevalence of hypertension in diabetes individuals was 38.4% in the study population. Among diabetic hypertensive subjects only 65.7% had been diagnosed, 58.4% were receiving treatment and 42% controlled their hypertension. Individuals from high socioeconomic status (AOR 2.60; 95% CI 1.16–5.83) had an increased likelihood of reporting diagnosis of hypertension. Individuals from medium (AOR 2.22; 95% CI 1.11–4.46) and high socioeconomic status (AOR 3.47; 95% CI 1.59–7.58) had increased chance of receiving treatment. In addition, individuals belonging to high socioeconomic status (AOR 2.53; 95% CI 1.14–5.63) were more likely to report of controlling hypertension.

Conclusions: This study indicated that hypertension is more prevalent among diabetic patients. Furthermore, diabetic hypertensive patients from the low socioeconomic status group are also less likely to be diagnosed and also less likely to receive treatment for hypertension. In addition, diabetic hypertensive patients from the low socioeconomic status were less likely to control hypertension compared with an individual belonging to the high socioeconomic status group. This reduced likelihood of receiving proper treatment will lead to a rapid increase in the prevalence of macrovascular and microvascular diseases among diabetic hypertensive patients.

Keywords

Diabetes, hypertension, diagnosis, treatment, control, SES, Bangladesh

Introduction

Although diabetes mellitus (DM) is associated with considerably increased risk of cardiovascular, retinopathy and nephropathy diseases, the presence of hypertension in the DM individual strikingly increases the risk.^{1,2} People with both DM and hypertension have approximately twice the risk of cardiovascular diseases (CVD) as non-DM people with hypertension.² In patients with DM, the prevalence of hypertension is up to three times more as compared to patients without DM.³ Clinical trials have consistently demonstrated the importance of hypertension control in patients with DM to the prevention of macrovascular and microvascular diseases.⁴ Therefore, detection, treatment and control of hypertension are highly desirable in preventing or slowing down the progression of macrovascular and microvascular complications in people with DM. The progress of DM in Bangladesh is increasing at a very fast pace, 4% in 1990 to 10% in 2011,⁵ and thus is likely to contribute to a significant burden of hypertension among this group and consequently increases the risk of CVD.

How socioeconomic status (SES) influences control and management of hypertension in the general population has been studied in a range of settings, with different samples.^{6–8} However, despite the clinical importance of the coexistence of DM and hypertension as comorbid conditions, the association of SES with diagnosis, treatment and control of hypertension in DM hypertensive patients has not been studied. Furthermore, although the relationship

between SES and health has been well documented, there is a lack of clear understanding about the combined impact of different SES measures, for example, education and wealth. Although these two variables have often been analysed independently,^{9,10} they are interrelated to each other at an individual level in reality. We do know both education and economic status positively affect health, but we do not know how the relationship would turn out when we consider two variables at once. It is possible that a DM hypertensive person, who does not have higher education but has higher economic status, has a higher likelihood of controlling and management of hypertension. It could also be possible that a DM hypertensive person with lower economic status, but with higher education, would have a higher likelihood of controlling and managing hypertension.

In addition, the issue of multicollinearity may emerge when these two variables were analysed independently. However, it is believed that education contributes to the socioeconomic development, which implies a high correlation between education and economic status. Thus, to avoid the problem of multicollinearity and to gauge SES more accurately, there is need to combine education and wealth status into one. Based on these considerations, using the first nationally representative sample of Bangladesh, we analysed if SES could affect the likelihood of diagnosis, treatment and control of hypertension in DM hypertensive patients.

Methods

Data source

This study used data from the 2011 Bangladesh Demographic Health Survey (BDHS), conducted by the National Institute for Population Research and Training of the Ministry of Health and Family Welfare of Bangladesh from 8 July to 27 December 2011.¹¹ A nationally representative household-based sample was created through a stratified, multistage cluster sampling strategy, constructing 600 primary sampling units (207 in urban areas and 393 in rural areas).

A total of 17,964 households were selected for interview, and 17,141 interviews were successfully completed, achieving a household response rate of 98%. Testing of the biomarker component, including and blood pressure measurements, and blood glucose testing, is a relatively new addition to 2011 BDHS and is administered to one-third of the households.¹¹ In total 8835 residents (4311 women and 4524 men) aged 35 or older were eligible for blood glucose measurement in those households, and 7565 took part, yielding a response rate of 86% (89% of women

and 83% of men). Of those participants, 879 had DM (fasting plasma glucose values of ≥ 7.0 mmol/L or currently taking medication to lower blood glucose). The 2011 BDHS used the HemoCue 201 + blood glucose analyzer in capillary whole blood obtained from the middle or ring finger from adults after an overnight fast for measuring fasting plasma glucose levels.¹¹

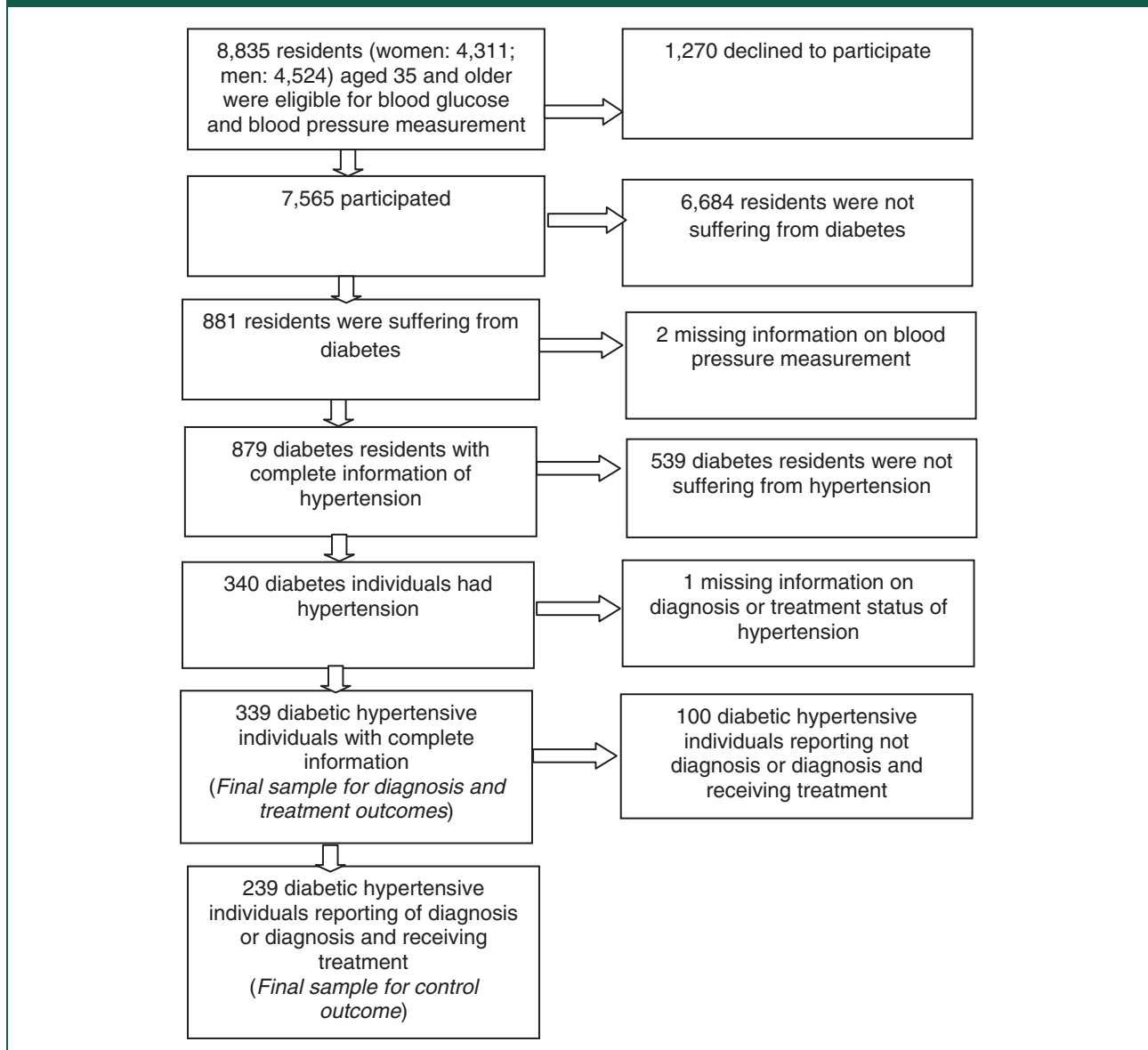
Among the DM participants 340 had hypertension (blood pressure levels ≥ 140 mmHg SBP or ≥ 90 mmHg DBP, or currently taking medication to lower their blood pressure). The 2011 BDHS used the LIFE SOURCE[®] UA-767 Plus Blood Pressure Monitor model to measure hypertension recommended by the World Health Organization (WHO).¹² The survey recorded blood pressure in the right arm of seated participants. Three measurements of both systolic and diastolic blood pressure were taken during the survey at approximately 10-min intervals between measurements. The average of the second and third measurements was used to report respondent's blood pressure values. After dropping any with missing data related to treatment status ($n = 1$), a total of 339 DM hypertensive individuals were selected for our analysis (Figure 1).

Measures

We analysed three outcome variables: diagnosis, treatment and control of hypertension among DM hypertensive individuals. We regarded participants as having been diagnosed with hypertension if they answered 'yes' when asked whether a doctor or any other health professional had told them they had hypertension. We considered DM hypertensive patients to be receiving treatment for hypertension if they reported currently using an antihypertensive medication. For respondents reporting diagnosis, or diagnosis and receiving treatment, we examined whether their hypertension was controlled, defined as blood pressure levels SBP < 140 mmHg or < 90 mmHg DBP. Binary variables were created to define each of the three outcome variables.

This study created a variable to define SES in the following manner. First, a binary variable was created to assess the level of the respondent's education according to the formal education system in Bangladesh, as either lower educated (below secondary education; 0–5 years of schooling) or higher educated (secondary or higher education; ≥ 6 years of schooling). Second, a binary variable was created to assess the wealth status of the respondents, as either poor or non-poor. The BDHS wealth index was constructed from data on household assets, including ownership of durable goods and dwelling characteristics.

Figure 1. From the original 8,835 eligible men and women aged 35 years and older, we obtained a final sample of 339 for diagnosis and treatment outcomes and 239 for control outcome for this study: 2011 Bangladesh Demographic Health Survey.



Principal components analyses were used to assign individual household wealth scores. Each household was assigned a score and the sample was then divided into population tertiles: poor, middle, rich.¹¹ In this study, individuals who live in households that belong to any other wealth tertile except the poor are designated as 'non-poor'. Finally, a composite variable of SES was created by combining wealth and education as follows: (1) low SES (poor and lower educated); (2) middle SES (either poor or lower educated); and (3) high SES (non-poor and higher educated).

This study also included several theoretically pertinent sociodemographic risk factors of control and management of DM and hypertension.

Statistical analyses

We estimated the age-adjusted prevalence of hypertension in individuals with DM by a direct standardisation method. Age-adjusted prevalence of diagnosis, treatment and control of hypertension among DM individuals were also calculated. We derived a reference population for the age-adjusted prevalence data by using the gender-specific sub-population of persons who had DM.

We used absolute percent difference and relative percent difference to measure disparity between low and high SES groups. The Slope Index of Inequality (SII) and the Relative Index of Inequality (RII) were used to

quantify socioeconomic inequalities of our measured outcomes. The SII was calculated as described by Mackenbach and Kunst.¹³ The gradient was determined with linear regression whereby the relative rank of the socioeconomic measurement factor was taken as predictor variable and the respective age-adjusted prevalence as outcome variable. For the estimation of the RII, the SII was divided by the overall prevalence of each of the outcome variables. Analyses were conducted using Stata version 12.0 (StataCorp. LP, College Station, USA) to adjust for sampling weights based on the complex survey design of BDHS.

To adjust for clustering of observations at multiple levels, data were analysed by using logistic multilevel modeling procedures.¹⁴ We specified a three-level model for binary response of each of the three outcome variables for individual i living in household j in cluster k of the form, $\pi_{ijk}: y_{ijk} \sim \text{Bernoulli}(1, \pi_{ijk})$. All models were created by using penalised quasi-likelihood approximation with second-order Taylor linearisation as implemented in MLwiN 2.30 software. Data of this study are reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.¹⁵

Ethical considerations

The data collection procedures for the BDHS were carried out with the approval of the ORC Macro-institutional review board. The survey protocol was reviewed and approved by the National Ethics Review Committee of the Bangladesh Ministry of Health and Family Welfare of Bangladesh. Before starting the interview, informed consent was obtained from individual respondents followed by an oral explanation by interviewers according to the guidelines of the BDHS. Participants were informed and instructed about the importance of fasting status prior to the investigations. Trained data collectors and biomarker staff performed face-to-face interviews in each of the selected households to obtain demographic and biomarker information about the household and family members. This study was considered to be exempt from a full review as it was based on an anonymous public use of a secondary data set with no identifiable information regarding the survey participants.

Results

Descriptive statistics

Nearly half of the participants (46.1%) were 35 to 54 years old, 64.2% were female, 93.1% were from male headed households, and 58% lived in rural areas

(Table 1). Approximately 73% of the sample individuals had no jobs, 36.4% were from Dhaka division, and 26.9% living in a large family (≥ 7 members). From the total sample population, 73.4% of individuals were currently married and 24.2% of the individuals were considered to be overweight or obese ($\text{BMI} \geq 25 \text{ kg/m}^2$). Regarding SES, approximately 30% were from low SES, 34% from medium SES, and the remaining 36.1% were from high SES (Table 1).

The age-adjusted prevalence of hypertension in DM individuals was 38.4% in the study population. Over 34% of the hypertension in DM hypertensive individuals was undetected (Table 1). More than half of the patients with detected hypertension were treated. A little more than two-fifths of the individuals treated had their hypertension controlled. Individuals belonging to the high SES group had higher diagnosis and treatment status than their counterparts. In addition, people belonging to the high SES group were more likely to report of controlling hypertension (Table 1). AD, RD, SII and RII indicated that diagnosis of hypertension, receipt of medication and achievement of treatment outcome were disproportionately higher among the high SES group (Table 2).

Multivariate analysis

Association between SES and diagnosis, treatment and control of hypertension. Relative to individuals belonging to the low SES, individuals from high SES (AOR [adjusted odds ratio] 2.60; 95% confidence interval [CI] 1.16–5.83; Table 3) had an increased likelihood of reporting diagnosis of hypertension. Individuals from medium (AOR 2.22; 95% CI 1.11–4.46) and high SES (AOR 3.47; 95% CI 1.59–7.58) had increased chance of receiving treatment. In addition, individuals belonging to high SES (AOR 2.53; 95% CI 1.14–5.63) were more likely to report of controlling hypertension compared with the individuals belonged to low SES (Table 3).

Association between other covariates and diagnosis, treatment and control of hypertension. Participant's age (60–64 or 65+ years) was independently associated with higher odds of diagnosis and treatment (Table 3). Among the DM hypertensive individuals those who had a large family were significantly more likely to be diagnosed and under antihypertensive medication. Being overweight/obese was associated with higher odds of diagnosis and being under antihypertensive medication and lower odds of controlling hypertension. Employed respondents were less likely to report of being under antihypertensive medication. In addition, DM hypertensive individuals aged 40–44 years

Table 1. Descriptive statistics according to age-adjusted prevalence of diagnosis, treatment and control of hypertension and sociodemographic characteristics among diabetes hypertensive individuals aged 35 or older: 2011, Bangladesh Demographic and Health Survey.

| Variables | n (%) | Age-adjusted prevalence % (95% CI) | | |
|---------------------------------------|------------|------------------------------------|---------------------|-------------------|
| | | Diagnosis (n = 339) | Treatment (n = 339) | Control (n = 239) |
| Age, years | | | | |
| 35–39 | 29 (9.1) | 56.1 (36.4–75.8) | 45.7 (24.0–67.3) | 51.3 (24.0–78.5) |
| 40–44 | 35 (9.4) | 54.3 (33.9–74.6) | 51.5 (31.3–71.8) | 21.2 (13.3–39.4) |
| 45–49 | 54 (14.9) | 63.1 (47.1–79.0) | 56.0 (40.2–71.9) | 46.9 (27.4–66.3) |
| 50–54 | 43 (12.7) | 63.8 (47.0–80.7) | 63.9 (46.9–80.8) | 44.9 (23.4–66.3) |
| 55–59 | 55 (17.6) | 72.5 (58.6–86.5) | 66.3 (52.5–80.3) | 40.3 (22.8–57.8) |
| 60–64 | 32 (9.9) | 75.8 (58.6–92.9) | 66.4 (47.3–85.3) | 54.0 (31.4–76.7) |
| 65+ | 91 (26.4) | 75.3 (64.5–86.1) | 61.8 (50.4–73.2) | 40.9 (28.2–53.6) |
| Respondent's sex | | | | |
| Male | 131 (35.8) | 55.3 (45.5–65.0) | 50.8 (40.8–60.8) | 40.0 (31.0–49.1) |
| Female | 208 (64.2) | 70.4 (63.2–77.6) | 61.0 (53.6–68.3) | 43.8 (35.2–52.3) |
| Living in patriarchal household | | | | |
| No | 26 (6.9) | 84.8 (70.4–99.3) | 81.7 (68.1–95.3) | 41.8 (27.6–55.9) |
| Yes | 313 (93.1) | 65.0 (58.9–71.2) | 57.7 (51.2–64.2) | 41.4 (34.1–48.8) |
| Region | | | | |
| Barisal | 39 (5.5) | 70.8 (59.2–82.5) | 61.4 (49.8–73.1) | 39.0 (28.3–49.7) |
| Chittagong | 74 (25.6) | 73.0 (61.1–84.8) | 64.8 (51.5–78.1) | 43.1 (32.4–53.8) |
| Dhaka | 66 (36.4) | 60.0 (48.1–72.0) | 51.8 (39.9–63.7) | 41.2 (27.4–54.9) |
| Khulna | 39 (8.3) | 61.2 (47.3–75.2) | 53.1 (39.1–67.2) | 30.7 (12.4–49.1) |
| Rajshahi | 47 (12.5) | 70.8 (60.0–81.6) | 64.9 (53.1–76.8) | 53.0 (37.7–68.2) |
| Rangpur | 35 (7.3) | 55.8 (38.6–73.1) | 52.6 (36.4–68.8) | 29.6 (11.5–47.6) |
| Sylhet | 39 (4.4) | 76.5 (60.0–92.9) | 80.0 (66.7–93.0) | 51.7 (35.7–67.6) |
| Place of residence | | | | |
| Rural | 158 (57.6) | 64.3 (56.1–72.4) | 58.3 (49.3–67.4) | 36.7 (27.9–45.5) |
| Urban | 181 (42.4) | 66.6 (58.3–74.8) | 58.9 (50.7–67.1) | 50.7 (40.6–60.9) |
| Living in a large family ^a | | | | |
| No | 236 (73.1) | 63.3 (56.1–70.4) | 55.7 (48.1–63.3) | 42.5 (33.3–51.7) |
| Yes | 103 (26.9) | 71.9 (61.2–82.5) | 64.2 (53.1–75.3) | 38.9 (27.3–50.5) |

(continued)

Table 1. Continued.

| Variables | n (%) | Age-adjusted prevalence % (95% CI) | | |
|---------------------------------|------------|------------------------------------|---------------------|-------------------|
| | | Diagnosis (n = 339) | Treatment (n = 339) | Control (n = 239) |
| No. of adults 35 years and over | | | | |
| 1 | 44 (12.5) | 55.3 (41.5–69.1) | 52.4 (38.4–66.4) | 54.7 (36.9–72.5) |
| 2 | 210 (64.2) | 66.6 (59.3–74.0) | 59.5 (51.5–67.6) | 42.3 (33.1–51.6) |
| 3+ | 85 (23.3) | 68.1 (54.0–82.1) | 60.7 (45.5–76.0) | 35.4 (23.2–47.6) |
| Currently married | | | | |
| No | 84 (26.6) | 64.7 (58.1–71.3) | 58.9 (51.8–65.9) | 37.1 (20.9–53.4) |
| Yes | 254 (73.4) | 67.6 (59.3–75.9) | 61.7 (53.4–70.1) | 43.7 (35.5–51.9) |
| Employment status | | | | |
| No | 234 (72.9) | 69.5 (62.5–76.5) | 62.7 (55.4–70.0) | 44.8 (36.3–53.2) |
| Yes | 105 (27.1) | 54.9 (44.7–65.0) | 46.2 (35.6–56.9) | 43.3 (28.3–58.3) |
| Overweight/obesity ^b | | | | |
| No | 249 (75.8) | 61.0 (53.8–68.3) | 52.3 (44.9–59.9) | 43.0 (34.8–51.3) |
| Yes | 90 (24.2) | 77.5 (68.4–86.5) | 70.3 (57.0–83.5) | 46.0 (33.6–58.4) |
| Socioeconomic status | | | | |
| Low | 93 (29.9) | 57.3 (47.2–67.4) | 46.6 (36.7–56.4) | 33.3 (22.6–44.0) |
| Medium | 114 (34.0) | 64.5 (53.6–75.5) | 59.9 (48.5–71.2) | 37.7 (27.5–47.8) |
| High | 132 (36.1) | 71.6 (63.2–80.0) | 66.4 (57.3–75.6) | 58.8 (47.7–69.9) |
| Prevalence | | 65.7 (59.8–71.6) | 58.4 (52.1–64.6) | 42.0 (35.0–49.1) |

^aNumber of family members 7 or over

^b ≥ 25 kg/m².

Numbers are unweighted and percentage are weighted

Table 2. Summary measures of SES inequality and diagnosis, treatment and control of hypertension among diabetes hypertensive individuals aged 35 or over: 2011, Bangladesh Demographic and Health Survey.

| Variable | Absolute disparity (AD) ^a | Relative disparity (RD) ^b | Slop index of inequality (SII) ^c | Relative index of inequality (RII) ^d |
|---------------------|--------------------------------------|--------------------------------------|---|---|
| Diagnosis (n = 339) | 14.3 | 1.25 | 21.27 | 0.32 |
| Treatment (n = 339) | 19.8 | 1.42 | 28.53 | 0.43 |
| Control (n = 239) | 25.5 | 1.77 | 30.23 | 0.73 |

^aArithmetic difference between high SES and low SES

^bThe ratio of high SES to low SES

^cUsing the formula: $Y * \sqrt{a} = a * \sqrt{a} + \beta * b * \sqrt{a} + e$; Y = prevalence rate of respective SES; a = size of SES; b = relative rank of SES; α = intercept; β = regression coefficient; e = error term.

^dSII was divided by the overall prevalence of each of the outcome variables

Table 3. Adjusted odds ratios for associations between SES and diagnosis, treatment and control of hypertension among diabetes hypertensive individuals aged 35 or older: 2011, Bangladesh Demographic and Health Survey.

| Variables | Diagnosis (n = 339) | | Treatment (n = 339) | | Control (n = 239) | |
|-------------------------------------|--------------------------|-------|-------------------------|-------|-------------------------|-------|
| | AOR (95% CI) | p | AOR (95% CI) | p | AOR (95% CI) | p |
| Age, years | | | | | | |
| 35–39 | 1.00 | – | 1.00 | – | 1.00 | – |
| 40–44 | 1.28 (0.44–3.73) | 0.653 | 1.26 (0.44–3.61) | 0.671 | 0.15 (0.03–0.68) | 0.014 |
| 45–49 | 2.17 (0.78–6.01) | 0.138 | 2.09 (0.77–5.67) | 0.147 | 0.78 (0.22–2.80) | 0.703 |
| 50–54 | 1.87 (0.62–5.65) | 0.266 | 2.78 (0.95–8.68) | 0.061 | 0.60 (0.15–2.36) | 0.468 |
| 55–59 | 2.46 (0.85–7.12) | 0.098 | 2.50 (0.88–7.10) | 0.085 | 0.50 (0.14–1.80) | 0.289 |
| 60–64 | 3.98 (1.11–14.33) | 0.034 | 2.99 (1.02–9.57) | 0.093 | 0.76 (0.18–3.21) | 0.703 |
| 65+ | 3.13 (1.02–9.60) | 0.047 | 2.88 (1.00–6.11) | 0.200 | 0.65 (0.16–2.59) | 0.540 |
| Respondent's sex | | | | | | |
| Male | 1.00 | – | 1.00 | – | 1.00 | – |
| Female | 0.48 (0.20–1.15) | 0.100 | 0.83 (0.36–1.92) | 0.669 | 0.69 (0.27–1.76) | 0.439 |
| Living in patriarchal household | | | | | | |
| No | 1.00 | – | 1.00 | – | 1.00 | – |
| Yes | 0.61 (0.19–1.94) | 0.402 | 0.51 (0.169–1.57) | 0.243 | 1.12 (0.40–3.13) | 0.827 |
| Region | | | | | | |
| Barisal | 1.00 | – | 1.00 | – | 1.00 | – |
| Chittagong | 0.99 (0.37–2.67) | 0.980 | 0.94 (0.38–2.33) | 0.898 | 0.94 (0.36–2.46) | 0.901 |
| Dhaka | 0.42 (0.16–1.11) | 0.080 | 0.42 (0.16–1.05) | 0.063 | 0.73 (0.26–2.04) | 0.547 |
| Khulna | 0.76 (0.25–2.25) | 0.614 | 0.80 (0.29–2.22) | 0.666 | 0.54 (0.17–1.70) | 0.292 |
| Rajshahi | 0.64 (0.22–1.84) | 0.407 | 0.53 (0.20–1.42) | 0.205 | 0.81 (0.27–2.44) | 0.713 |
| Rangpur | 0.54 (0.18–1.61) | 0.268 | 0.71 (0.25–2.00) | 0.512 | 0.47 (0.13–1.73) | 0.255 |
| Sylhet | 0.66 (0.22–2.00) | 0.459 | 0.99 (0.35–2.84) | 0.985 | 1.02 (0.34–3.08) | 0.971 |
| Place of residence | | | | | | |
| Rural | 1.00 | – | 1.00 | – | 1.00 | – |
| Urban | 0.93 (0.53–1.65) | 0.812 | 0.80 (0.46–1.38) | 0.429 | 1.36 (0.73–2.52) | 0.332 |
| Living in large family ^a | | | | | | |
| No | 1.00 | – | 1.00 | – | 1.00 | – |
| Yes | 2.12 (1.07–4.22) | 0.032 | 1.90 (1.00–3.60) | 0.049 | 0.89 (0.46–1.72) | 0.725 |

(continued)

Table 3. Continued.

| Variables | Diagnosis (n = 339) | | Treatment (n = 339) | | Control (n = 239) | |
|---------------------------------|-------------------------|-------|-------------------------|-------|-------------------------|-------|
| | AOR (95% CI) | p | AOR (95% CI) | p | AOR (95% CI) | p |
| No. of adults 35 years and over | | | | | | |
| 1 | 1.00 | – | 1.00 | – | 1.00 | – |
| 2 | 0.93 (0.41–2.12) | 0.866 | 0.77 (0.35–1.71) | 0.519 | 0.61 (0.24–1.55) | 0.297 |
| 3+ | 0.87 (0.33–2.34) | 0.787 | 0.66 (0.26–1.72) | 0.398 | 0.58 (0.19–1.74) | 0.332 |
| Currently married | | | | | | |
| No | 1.00 | – | 1.00 | – | 1.00 | – |
| Yes | 1.79 (0.80–4.02) | 0.157 | 1.45 (0.67–3.12) | 0.343 | 1.77 (0.72–4.36) | 0.212 |
| Employment status | | | | | | |
| Not employed | 1.00 | – | 1.00 | – | 1.00 | – |
| Employed | 0.60 (0.26–1.39) | 0.232 | 0.34 (0.15–0.77) | 0.009 | 0.62 (0.25–1.53) | 0.296 |
| Overweight/Obesity ^b | | | | | | |
| No | 1.00 | – | 1.00 | – | 1.00 | – |
| Yes | 2.35 (1.16–4.74) | 0.018 | 2.51 (1.30–4.85) | 0.006 | 0.42 (1.03–1.42) | 0.048 |
| Socioeconomic status | | | | | | |
| Low | 1.00 | – | 1.00 | – | 1.00 | – |
| Medium | 1.52 (0.74–3.12) | 0.258 | 2.22 (1.11–4.46) | 0.024 | 2.07 (0.87–4.92) | 0.100 |
| High | 2.60 (1.16–5.83) | 0.020 | 3.47 (1.59–7.58) | 0.002 | 2.53 (1.14–5.63) | 0.020 |

CI: Confidence interval; AOR: Adjusted odds ratio.

^aNumber of family members 7 or over; ^b≥25 kg/m².

Bold numerals indicate significant association.

were less likely to report of controlling hypertension (Table 3).

Discussion

Main finding of this study

The results from a nationally representative large survey in Bangladesh showed that hypertension is extremely common among Bangladeshi men and women with DM, with this disease occurring in more than one in three DM (38.4%) individuals. The study indicated that SES plays an important role in diagnosis and treatment of hypertension in DM hypertensive individuals in Bangladesh; it also appears to influence the likelihood of a DM hypertensive patient achieving normal blood pressure levels while being under antihypertensive medication.

Strengths and limitations of this study

The main strength of this study is that the data were collected from a large and randomly selected representative population. The data contained information on potential confounding factors, with a low proportion of missing information. Moreover, the BDHS ensures that interviewers were trained extensively and standardised measurement tools and techniques were used. The results of the current study should be considered in light of some limitations. First, due to the cross-sectional nature of this analysis, temporal order cannot be determined. Second, because our selection of variables was constrained by the preexisting BDHS data, we were unable to include additional, potentially important variables related to DM and hypertension, such as quantity and quality of diet, smoking status of the patients and physical

activity. Third, the study can be criticised for using an indirect measure of household wealth. However, due to unavailability of reliable and comparable income or consumption data across households of all social classes, an asset-based index is generally considered as a good proxy for household economic status.

Finally, the estimated prevalence of hypertension might be underestimated because only persons who had measured high blood pressure during the examination and those who reported taking pharmacologic treatment to achieve control of hypertension were included in the analysis. Certain participants who might have received a diagnosis of hypertension previously but who had normal blood pressure measurements during the examination, perhaps as a result of lifestyle habits (e.g. diet and exercise), were not included as having hypertension in the analysis.

Comparison with other studies

The obtained high age-adjusted prevalence of hypertension among DM patients indicates an impending pandemic of diabetic cardiovascular diseases in Bangladesh with its potential economic consequences. The present study revealed that 42% of DM hypertensive patients who were receiving antihypertensive medication could control their hypertension. Because we used a representative community sample, our results are not directly comparable to the prevalence of other small scale and local studies. However, this figure is much lower than the previous small scale studies (52.9–80.1%)^{16–18} conducted in several developing and developed countries. By considering these situations, population-based awareness raising about hypertension and effective education among DM patients are necessary in Bangladesh.

This study indicated that DM hypertensive individuals belonging to the low SES group were less likely to diagnosis and also less likely to be under antihypertensive medication. These findings are in accordance with some of the previous studies conducted in both developed^{9,19} and developing nations.²⁰ There might be some barriers to the effective treatment and diagnosis of hypertension among DM hypertensive individuals belonging to the lower SES group in Bangladesh. These include failure to understand the importance of adhering to the treatment of hypertension, lack of family support, inadequate health facilities for diagnosis, insufficient specialist services for the management of DM, the absence of health educators, a costly and complex transportation system from village to city and a lack of health information.²¹ Another potential

barrier may be due to the discrimination by health-care providers and office staff. Clinicians may be busy only with managing diabetes for people with lower SES and consequently would not be willing or able to increase the antihypertensive medications. A study in Europe revealed that as the treatment of diabetes became more sophisticated, individuals with higher SES tended to respond to new treatment practices and benefited more than individuals with lower SES.²²

Another important finding is that the low SES group showed a lower probability of having normal blood pressure levels under treatment. Low literacy, lack of structured education and insecure economic status of DM hypertensive patients belonging to the low SES group lead to the dominance of incorrect beliefs about hypertension and its care.²³ These beliefs may have serious consequences, amounting to stopping the treatment or refusing the diagnosis of hypertension and thereby increasing the chance of uncontrolled hypertension. The relationship between SES and control of hypertension should be explored further and the reasons for the particularly low rates of control in individuals of low SES should be determined.

In the multivariate analysis, we found that old age (60 years or over) was independently associated with higher hypertension diagnosis and treatment, which is consistent with other reports.^{24,25} In contrast, the higher diagnosis and treatment levels among the older age group did not correspond to better hypertension control. In fact, the older adults, on the contrary, were less likely to have their hypertension adequately controlled compared with younger adults despite their higher awareness and treatment rates. A possible explanation might be that the older people may pay more attention to their health but lack financial means to afford costly antihypertensive drugs.²⁶ The higher control rates among traders may reflect their ability to access medical care, and ability to afford antihypertensive medications.

Another interesting finding is that living in a large family was significantly related to higher hypertension diagnosis and treatment. There may be a number of reasons for this. DM hypertensive individuals from a large family may receive more familial support compared with those from a small family. They may have more contact with family members and receive encouragement to seek care. Our findings also show that obesity was associated with higher levels of diagnosis and treatment but lower levels of hypertension control. These findings are consistent with other reports,^{27,28} It has been suggested that obesity positively influences blood pressure checking

and prescription of medication for intervention, and hence, higher awareness and treatment levels. This study shows that employed persons were less likely to receive treatment. The possible reason may be due to the fact that employed persons in our sample data were less likely to suffer from hypertension compared with the unemployed individual. Moreover, an additional analysis was performed in our study to support this hypothesis, and DM hypertensive patients with jobs were found to have a low prevalence of hypertension compared with those who had no jobs.

Implications for practice and further research

The present findings highlight the need for strategies, programmes and policies that aim to combat hypertension among DM hypertensive individuals. Special attention should be given to low SES groups most affected. Such programmes can include interventions to improve the knowledge, attitude and behaviors of all sectors of the community including patients and health professionals in the context of prevention, early diagnosis, adherence to treatment and control of hypertension. Further longitudinal research is needed to fully tease apart this complex relationship and understand the underlying mechanisms.

Conclusions

This study indicated that hypertension is more prevalent among DM patients. Furthermore, DM hypertensive patients from the low SES group are also less likely to diagnose and also less likely to receive treatment for hypertension. In addition, DM hypertensive patients from the low SES group were less likely to control hypertension compared with the individuals belonging to the high SES group. This reduced likelihood of receiving proper treatment will lead to a rapid increase in the prevalence of macrovascular and microvascular diseases among DM hypertensive patients.

Declarations

Competing interests: None declared

Funding: None declared

Guarantor: MR

Ethical approval: The data collection procedures for the BDHS were carried out with the approval of the ORC Macro-institutional review board. The study protocol was reviewed and approved by the National Ethics Review Committee of the Ministry of Health and Family Welfare of Bangladesh.

Contributorship: MR had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: MR; acquisition of data: MR; analysis and interpretation of data: MR, SHE, MJI, MGM, KASMS; drafting of the manuscript: MR. Critical revision of the manuscript for important intellectual content: MR, SHE; statistical analysis: MR. All authors commented on and approved the final draft.

Acknowledgements: We are grateful to the MEASURE DHS for providing us with the data set. In addition, we would like to acknowledge all individuals and institutions in Bangladesh involved in the implementation of the 2011 BDHS.

Provenance: Not commissioned; peer-reviewed by Bruce Currey

References

1. Tesfaye S, Chaturvedi N, Eaton SE, Ward JD, Manes C and Ionescu-Tirgoviste C. EURODIAB prospective complications study group: vascular risk factors and diabetic neuropathy. *N Engl J Med* 2005; 352: 341–350.
2. Sowers JR, Epstein M and Frohlich ED. Diabetes, hypertension, and cardiovascular disease: an update. *Hypertension* 2001; 37: 1053–1059.
3. Sharma SK, Ruggerenti P and Remuzzi G. Managing hypertension in diabetic patients – focus on trandolapril/verapamil combination. *Vasc Health Risk Manag* 2007; 3: 453–465.
4. Adler A, Stratton IM and Neil HAW. Association of systolic blood pressure with macrovascular and microvascular complications of type 2 diabetes (UKPDS 36): prospective observational study. *BMJ* 2000; 31: 412–419.
5. Saquib N, Saquib J and Ahmed T. Cardiovascular diseases and type 2 diabetes in Bangladesh: a systematic review and meta-analysis of studies between 1995 and 2010. *BMC Public Health* 2012; 12: 434.
6. Cha SH, Park HS and Cho HJ. Socioeconomic disparities in prevalence, treatment, and control of hypertension in middle-aged Koreans. *J Epidemiol* 2012; 22: 425–432.
7. Gulliford MC, Mahabir D and Rocke B. Socioeconomic inequality in blood pressure and its determinants: cross-sectional data from Trinidad and Tobago. *J Hum Hypertens* 2004; 18: 61–67.
8. Minor D, Wofford M and Wyatt SB. Does socioeconomic status affect blood pressure goal achievement? *Curr Hypertens Rep* 2008; 10: 390–397.
9. Bachmann MO, Eachus J, Hopper CD, et al. Socioeconomic inequalities in diabetes complications, control, attitudes and health service use: a cross-sectional study. *Diabetic Med* 2003; 20: 921–929.
10. Cai Le, Dong Jun, Shu hakun, Yichun Lu and Jie T. Socioeconomic differences in diabetes prevalence, awareness and treatment in rural southwest China. *Trop Med Int Health* 2011; 16: 1070–1076.
11. NIPORT, Mitra and Associates and Macro International. *Bangladesh demographic and health survey 2007*. Dhaka, Bangladesh and Calverton,

- Maryland, USA: National Institute of Population Research and Training, Mitra and Associates, and Macro International, 2009.
12. World Health Organization (WHO). *Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia: report of a WHO/IDF consultation*. Geneva: WHO, 2006.
 13. Mackenbach JP and Kunst AE. Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Soc Sci Med* 1997; 44: 757–771.
 14. Goldstein H. *Multilevel statistical models*. London, UK: Arnold, 2003.
 15. Von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet* 2007; 370: 1453–1457.
 16. Berraho M, Youness EA, Abdelilah B, Karima EL, Rhazil MC and Chakib N. Hypertension and type 2 diabetes: a cross-sectional study in Morocco (EPIDIAM Study). *Pan Afr Med J* 2012; 11: 52.
 17. Anwer Z, Sharma PK, Garg VK, Kumar N and Kumar A. Hypertension management in diabetic patients. *Eur Rev Med Pharmacol Sci* 2011; 15: 1256–1263.
 18. Kawther EL and Rizvi S. Control of hypertension among type II diabetics. *Oman Med J* 2010; 25: 32–36.
 19. Evans JMM, Newton RW, Rutas DA, MacDonald TM and Morris AD. Socio-economic status, obesity and prevalence of type 1 and type 2 diabetes mellitus. *Diabet Med* 2000; 17: 478–480.
 20. Fisher-Hoch SP, Vatcheva KP, Laing ST, et al. Missed opportunities for diagnosis and treatment of diabetes, hypertension, and hypercholesterolemia in a Mexican American population, Cameron County Hispanic Cohort, 2003–2008. *Prev Chronic Dis* 2012; 9: 110298.
 21. The World Bank. *NCDs policy brief – Bangladesh*. The World Bank, South Asia Human Development, Health Nutrition, and Population, 2011, The World Bank Publishing Group.
 22. Forssas E, Keskimaki I, Reunanen A and Koskinen S. Widening socioeconomic mortality disparity among diabetic people in Finland. *Eur J Pub Health* 2003; 13: 38–43.
 23. Hosik M, JongWha C and Rajesh B. Sociodemographic risk factors of diabetes and hypertension prevalence in Republic of Korea. *Int J Hypertens* 2010; pii: 410794. doi:10.4061/2010/410794.
 24. Wang Y and Wang QJ. The prevalence of prehypertension and hypertension among US adults according to the new joint national committee guidelines: new challenges of the old problem. *Arch Intern Med* 2004; 164: 2126–2134.
 25. Muntner P, Gu D, Wu X, et al. Factors associated with hypertension awareness, treatment, and control in a representative sample of the Chinese population. *Hypertension* 2004; 43: 578–585.
 26. Buabeng OK, Matowe L and Plange-Rhule J. Unaffordable drug prices: the major cause of non-compliance with hypertension medication in Ghana. *J Pharm Pharm Sci* 2004; 7: 350–352.
 27. Agyemang C, Bruijnzeels MA and Owusu-Dabo E. Factors associated with hypertension awareness, treatment, and control in Ghana, West Africa. *J Hum Hypertens* 2006; 20: 67–71.
 28. Chen R, Tunstall-Pedoe H, Morrison C, Connaghan J and A'Brook R. Trends and social factors in blood pressure control in Scottish MONICA surveys 1986–1995: the rule of halves revisited. *J Hum Hypertens* 2003; 17: 751–759.