Working paper

The rapid rise of diabetes in Bangladesh and its drivers: A repeated cross-sectional analysis of nationally representative data

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Abstract

Background

The emergence of diabetes as a major public health issue has been particularly rapid in South Asia. Repeated nationally representative data with a blood glucose or HbA1c measurement has thus far not been available for any South Asian country. There is, thus, a large degree of uncertainty as to how prevalence of diabetes has changed at the country level and which population-level changes are driving these trends. Taking advantage of recently released nationally representative survey data from 2011 and 2017/2018 in Bangladesh, this study aimed to determine i) the change in diabetes prevalence at the national level, ii) which population groups were disproportionately affected, and iii) which population-level factors appear to drive the change in diabetes prevalence at the country level.

Methods

We pooled data from the 2011 and 2017/2018 Demographic and Health Surveys. Diabetes was defined as reporting a past diagnosis, being on regular treatment for diabetes, or having a fasting plasma glucose $\geq$7·0 mmol/L. Based on logistic regression models, we estimated changes in the prevalence of diabetes between 2011 and 2017/2018, both at the national level and across socioeconomic groups and regions. Using a counterfactual scenario analysis, we then examined the contribution of population aging, urbanization, and changes in household wealth and mean BMI to changes in diabetes prevalence at the population level.

Findings

Among adults aged 35 and older, the prevalence of diabetes increased from 12.1% (95% CI: 11.1 – 13.1) in 2011 to 14.4% (95% CI: 13.3, 15.5) in 2017/2018. Diabetes prevalence grew disproportionately fast among population groups with higher household wealth, more education, and in three regions (Dhaka, Chittagong, and Khulna). Between 2011 and 2017/2018, mean BMI increased from 20·9 kg/m^2 (95% CI: 20·8 – 21·1) to 22·5 kg/m^2 (95% CI: 22·4 – 22·7), and obesity prevalence from 19·9% (95% CI: 18·6 – 21·2) to 34·8% (95% CI: 33·2 – 36·4), respectively. In counterfactual analyses, we found that both the national rise and the group-specific trends were almost entirely attributable to increasing BMI.

Interpretation

Diabetes prevalence in Bangladesh has increased rapidly between 2011 and 2017/2018, with the increase being almost entirely attributable to a dramatic rise in body weight. Our findings suggest that focusing on reducing unhealthy body weight is critical for stemming the rise of diabetes in South Asia.

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Research in context

Evidence before this study

We searched PubMed for work published between Jan 1, 1990, and Oct 31, 2021, with variations of the search terms “diabetes”, “change”, “trend”, “South Asia”, and “Bangladesh” in the title or abstract. The vast majority of studies on diabetes prevalence in South Asia are cross-sectional analyses that are unable to examine trends over time. The few available estimates of changes in diabetes prevalence in South Asia are model-driven projections or based on samples that are not nationally representative.

Added value of this study

Bangladesh has one of the largest number of individuals with diabetes globally. However, due to a lack of repeated nationally representative data with fasting blood glucose or HbA1c measurements, it is unclear how the prevalence of diabetes has changed over time in Bangladesh or any other South Asian country. The 2011 and the recently released 2017/2018 Bangladesh Demographic and Health Surveys allow us to address this research gap. To our knowledge, our study provides the first nationally representative evidence on trends in the prevalence of diabetes in the South Asian context, both nationally and across subpopulations. In addition, we identify proximal and distal drivers of changes in diabetes prevalence at the national level and assess their relative importance by applying recently developed counterfactual analyses. Unlike cohort studies which can only identify individual-level risk factors for diabetes, we were able to determine the drivers of changes in diabetes prevalence at the population level. We show that the rise in diabetes in the country, as well as changes in the sociodemographic trends of diabetes between these years, can be almost entirely attributed to a rapid increase in mean BMI. The magnitude of this increase in BMI was substantially larger than has previously been estimated.

Implications of all the available evidence

Bangladesh is faced with a rapidly increasing diabetes prevalence that is mainly driven by a steep increase in body weight. Our findings suggest that public health efforts to minimize further rises in diabetes prevalence in South Asia should focus on curbing the increase in unhealthy body weight.

Introduction

Low- and middle-income countries (LMICs) bear the greatest burden of diabetes, with 79% of individuals with diabetes worldwide residing in LMICs in 2019. Due to an ongoing epidemiological transition from communicable to non-communicable diseases combined with population growth and aging, LMICs will also be faced with the highest number of new cases in the future.[2] Compared to other world regions, diabetes has emerged particularly rapidly as an important public health problem in South Asia over the last three decades.[3] The International Diabetes Federation estimates that in 2019, approximately a quarter of all adults worldwide aged 20-79 years with diabetes were residing in South Asia.[1] Individuals of South Asian ethnicity tend to develop diabetes at a younger age and at lower body mass index (BMI) values compared with other ethnicities.[4,5] A variety of genetic, nutritional, and environmental factors have been hypothesized to be responsible for this phenomenon.[3,6]

Even though cohort studies have analyzed changes in diabetes prevalence in South Asia and suggest that the region is experiencing one of the fastest increases in diabetes prevalence globally,[7] several research gaps persist, as repeated nationally representative data with blood glucose or glycosylated hemoglobin (HbA1c) measurements have not been available so far. Firstly, it is unclear how the prevalence of diabetes has changed over time at the country level and, secondly, whether and how this change has occurred differently across population groups. This information is critical for the planning and targeting of public health and health system efforts to curb the diabetes epidemic in the region. Thirdly, while cohort studies in the region have been able to identify individual-level risk factors for diabetes, including unhealthy weight,[8–10] it is unclear whether population-level changes in these risk factors are the main drivers of changes in diabetes prevalence at the national level and across subpopulations. The reason underlying this uncertainty is that such an analysis requires repeated nationally representative cross-sectional data on diabetes, which has thus far not been available for any country in South Asia. This information, however, is essential for developing the most effective population-based prevention strategies.

The 2011 along with the recently released 2017/2018 Bangladesh Demographic and Health Surveys provide an unique opportunity to address these research gaps. To our knowledge, we provide the first evidence on diabetes trends in a South Asian country based on repeated nationally representative data with fasting blood glucose measurements. We aimed to determine the change in the prevalence of diabetes at the national level and trends in this change across subpopulations. We also use a modern counterfactual approach to quantify the degree to which population-level changes in risk factors – including population aging, urbanization, rising wealth, and rising BMI – appear to drive these trends at the national and subpopulation level.

Methods

Data

This study is based on the 2011 and 2017/2018 Bangladesh Demographic and Health Surveys (BDHSs). The BDHS is a nationally representative household survey which uses a two-stage stratified cluster sampling design. In each survey round, administrative divisions were stratified into rural areas, city corporations, and areas other than city corporations. Afterwards, enumeration areas (EAs) were selected independently from each stratum (first stage) based on a list from the 2011 Population and Housing Census with selection probability proportional to EA population size. In the second stage, a complete household listing was compiled and used to draw an equal probability sample of households in each of the selected EAs. Importantly, both surveys measured blood glucose in a consistent manner by taking blood samples from the middle or ring finger of respondents after an overnight fast of at least eight hours. In 2011, the blood glucose levels in whole blood measured with the HemoCue+ blood glucose analyzer were multiplied by 1.11 to obtain the plasma glucose equivalent values, while the HemoCue 201 RT used in 2017/2018 automatically performed this adjustment. Both surveys used lightweight electronic SECA scales and measuring boards made by Shorr Productions to determine body weight and standing height. In addition to blood glucose and body size measurements, the surveys collected comprehensive sociodemographic information and asked further diabetes-related questions (e.g., previous clinical diagnoses or prescribed medications). Further details regarding the survey designs are available in the official BDHS survey reports.[11,12]

Main outcome and variable definitions

Our primary outcome is a binary indicator for having diabetes which we set to one if at least one out of three conditions was satisfied: the respondent reported a past diagnosis by a clinician, reported being on an antidiabetic medication, or had fasting plasma glucose values greater than or equal to 7·0 mmol/L (WHO cut-off point[11]). We classified the diabetes status as missing if information for any of the three variables was not available.

As part of our analysis, we investigated the contribution of sociodemographic and biological variables to diabetes trends. Specifically, we examined the role of population aging, urbanization, and living standards by using information on respondents' age (measured continuously), whether they lived in an urban or rural area (binary indicator), and a continuous household wealth index. The calculation of the latter based on a Principal Component Analysis is described in the appendix.[5,13–15] Based on surveyor-measured height and weight, we also assessed the importance of changes in BMI, as it is a major individual-level risk factor for the development of diabetes.[16,17] For our analysis, we classified individuals with a BMI of at least 23·9 $\frac{kg}{m^2}$ and of at least 19·2 $\frac{kg}{m^2}$ as obese and overweight or obese, respectively. A recent analysis showed that these values are ethnicity-specific BMI cutoffs for South Asian adults that are risk-equivalent for the incidence of type 2 diabetes as a BMI of 30·0 $\frac{kg}{m^2}$ and a BMI of 25·0 $\frac{kg}{m^2}$ in White populations.[18]

As part of subgroup analyses, we investigated differences across sex (male versus female), levels of education (no education, primary incomplete, primary complete, secondary incomplete, and secondary complete or higher), the five household wealth quintiles, regions (the first-level administrative divisions of Bangladesh), and place of residence (urban versus rural areas). In 2015, a new administrative division, Mymensingh, was formed out of areas which previously belonged to Dhaka. We considered observations from these areas as being from Dhaka in both survey rounds such that borders between regions were consistent across years.

Statistical Methods

We restricted our analysis to adults above 35 years of age because both surveys collected plasma blood glucose measurements for this age group. Furthermore, we excluded pregnant women and observations with either missing BMI or diabetes information. To ensure that our sample was representative of the age distribution of the Bangladesh population above age 35, we adapted the household weights based on the age distribution of Bangladesh according to the United Nations World Population Prospects population estimates for 2011 and 2017.[19] We present unweighted descriptive statistics for our final sample and the distribution of variables across years. Weighted results are available in the online appendix.

We first estimated the prevalence of diabetes at the national level in 2011 and in 2017/2018. Second, we estimated the observed change in the national prevalence of diabetes between 2011 and 2017/18 and the relative importance of potential drivers of this change. Our approach for this analysis was inspired by recent methodological developments for decomposition analyses[20,21] and measured the relative importance of different potential drivers by asking the counterfactual question "how much would the prevalence of diabetes have grown if the specific risk factor in question did not change between 2011 and 2017?" Specifically, we estimated the following regression models on the pooled 2011 and 2017/2018 data:

(1a) $Diabetes = \beta_0 + \beta_1 * year + \beta_2 * sex + \beta_3 * age$

(1b) $Diabetes = \beta_0 + \beta_1 * year + \beta_2 * sex + \beta_3 * age + \beta_4 * BMI$

(1c) $Diabetes = \beta_0 + \beta_1 * year + \beta_2 * sex + \beta_3 * age + \beta_4 * urban$

(1d) $Diabetes = \beta_0 + \beta_1 * year + \beta_2 * sex + \beta_3 * age + \beta_4 * wealth$

Using the model coefficients, we then predicted two sets of diabetes change (separately for each model): (1) the observed change in diabetes prevalence (the predicted prevalence of diabetes in 2017/2018 minus the predicted prevalence of diabetes in 2011 using the actual observed data in both years); and (2) the counterfactual change in diabetes prevalence when holding each main risk factor fixed at its mean value in 2011 (the predicted prevalence of diabetes in 2017/2018 holding the main risk factor at its 2011 value but using the observed 2017/18 data for all the other variables minus the predicted prevalence of diabetes in 2011 using the observed 2011 data). All the models adjusted for age flexibly using cubic B-splines with three interior knots. Since some of the potential drivers may lie on the causal pathway between other drivers and diabetes, we only included one potential driver in the regression models at a time.

After considering changes at the national level, we similarly estimated the gradients across socioeconomic/geographic groups in each year. We then determined the observed and counterfactual trends among these subpopulations and identified groups which experienced the largest increases in the prevalence of diabetes. Among the subpopulations, we only evaluated the contribution of BMI because the results we obtained for the national level indicated that BMI is the most important driver of change in diabetes prevalence in Bangladesh. This subgroup analysis used similar regressions to (1b) above, but additionally included an interaction between year and group:

$$(2)\quad Diabetes = \beta_0 + \beta_1 * year * group + \beta_2 * sex + \beta_3 * age + \beta_4 * BMI,$$

where group is one of five categorical socioeconomic and geographic variables that we examined (sex, education, wealth, region, and urban versus rural residence). Finally, we calculated the national as well as the group-specific levels of BMI and obesity prevalence in each year.

All of our analyses adjust for the complex sample design of DHS surveys and were weighted to obtain nationally representative estimates. While we obtained the standard errors of descriptive statistics through Taylor series linearization, the presented approximate normal confidence intervals for post-estimation predictions are based on a bootstrapping approach that accounts for the complex survey design through a scale adjustment applied to 1000 sets of replicate weights.[22–24] We used R version 4·0·4 for our statistical analysis.

Results

Sample characteristics

In total, 8,835 and 8,117 adults aged 35 and older were eligible for a blood glucose measurement in 2011 and 2017/2018, respectively. Across both surveys, 2,604 (15·4%) participants eligible for a blood glucose measurement were excluded from the analysis because they had missing information for at least one of the three variables needed to define diabetes. A further 342 (2·0%) were excluded because they had missing BMI information and 47 (<0·1%) because they reported to be pregnant at the time of data collection. A detailed flowchart is provided in the appendix (Figure S1). The characteristics of participants who were excluded due to missing values are provided in table S2. The final sample for analysis consisted of 13,959 individuals; 7,276 in 2011 and 6,683 in 2017/2018 (Table 1). The datasets had no missing observations for sex, age, education, household wealth, region, and place of residence.

	2011 (N=7276)	2017 (N=6683)
Sex		
Male	3621 (49·8%)	3261 (48·8%)
Female	3655 (50·2%)	3422 (51·2%)
Age		
35-44	2645 (36·4%)	2442 (36·5%)
45-54	2181 (30·0%)	1707 (25·5%)
55-64	1236 (17·0%)	1376 (20·6%)
65-74	755 (10·4%)	781 (11·7%)
75-84	311 (4·3%)	270 (4·0%)
85-94	101 (1·4%)	84 (1·3%)
95-104	47 (0·6%)	23 (0·3%)
Education		
No education	3220 (44·3%)	2581 (38·6%)
Primary incomplete	1683 (23·1%)	1499 (22·4%)
Primary complete	775 (10·7%)	657 (9·8%)
Secondary incomplete	925 (12·7%)	1092 (16·3%)
Secondary complete or higher	673 (9·2%)	854 (12·8%)
Region		
Barisal	826 (11·4%)	730 (10·9%)
Chittagong	1063 (14·6%)	845 (12·6%)
Dhaka	1275 (17·5%)	1578 (23·6%)
Khulna	1182 (16·2%)	1010 (15·1%)
Rajshahi	1012 (13·9%)	871 (13·0%)
Rangpur	1036 (14·2%)	911 (13·6%)
Sylhet	882 (12·1%)	738 (11·0%)
Place of residence		
Urban	2397 (32·9%)	2261 (33·8%)
Rural	4879 (67·1%)	4422 (66·2%)
BMI		
Mean (SD)	21·0 (3·9)	22·5 (4·2)
Median [Min, Max]	20·4 [12·9, 58·4]	22·1 [12·2, 46·7]
Overweight or obese		
Yes	4633 (63·7%)	5148 (77·0%)
Obese		
Yes	1538 (21·1%)	2302 (34·4%)
Diagnosed with diabetes by a clinician		
Yes	415 (5·7%)	486 (7·3%)
Currently taking antidiabetic medication		
Yes	293 (4·0%)	403 (6·0%)
Fasting plasma glucose (mmol/l)		
Mean (SD)	5·9 (1·5)	5·9 (2·0)
Median [Min, Max]	5·8 [1·6, 27·1]	5·5 [2·4, 25·2]
Diabetes		
Yes	933 (12·8%)	946 (14·2%)

Table 1. Sample characteristics by survey year (unweighted)

We used Asian-specific BMI cutoffs to classify respondents as overweight or obese (BMI ≥19·2 $\frac{kg}{m^2}$) and obese (BMI ≥23·9 $\frac{kg}{m^2}$). Diabetes was defined as reporting to be currently taking antidiabetic medication, reporting a past diagnosis of diabetes, or having a fasting plasma glucose greater than or equal to 7·0 mmol/L. Dhaka includes observations from the new administrative division Mymensingh, which was formed in 2015.

While across both surveys most participants reported having not completed primary school, educational attainment was higher in the 2017/18 than in the 2011 sample. The proportion of participants living in each of the first-level administrative divisions remained relatively stable across survey rounds, except for a relatively higher share from the division Dhaka (or the new division Mymensingh). The proportion of participants living in urban areas was only slightly higher in 2017/18 (32·9%) than in 2011 (33·8%). Both the proportion of respondents who had been diagnosed with diabetes (2011: 5·7%; 2017/2018: 7·3%) and the share among these diagnosed participants who reported taking an antidiabetic medication (2011: 69·9%; 2017/2018: 82·9%) increased between the two surveys.

Change in diabetes prevalence from 2011 to 2017/18

The prevalence of diabetes among those aged 35 years and older in Bangladesh increased from 12·1% (95% CI: 11·1% – 13·1%) in 2011 to 14·4% (95% CI: 13·3% – 15·5%) in 2017/18. In both 2011 and 2017/2018, diabetes prevalence was higher among groups with more education and more household wealth, and in urban areas (Figure 1). Differences in the prevalence of diabetes by sex were small in both years.

The increase in diabetes prevalence at the national level was attributable to only three regions, namely Dhaka (increase of 5·5 percentage points [95% CI: 2·4 – 8·7]), Chittagong (increase of 3·3 percentage points [95% CI: -1·2 – 7·9]), and Khulna (increase of 2·6 percentage points [95% CI: -0·1 – 5·4]) (Figure 1). Participants with a higher socioeconomic status (SES) experienced higher increases in diabetes prevalence. Whereas the prevalence of diabetes hardly changed among participants in the two poorest household wealth quintiles between the two surveys, prevalence increased from 22.2% (95% CI: 19.6% – 24.8%) to 29.0% (95% CI: 26.1% – 31.8%) among participants in the highest household wealth quintile and respondents with completed primary or secondary educated tended to be more affected by the rising burden of disease. The magnitude of the increase in the prevalence of diabetes was similar across rural and urban areas and among both males and females.

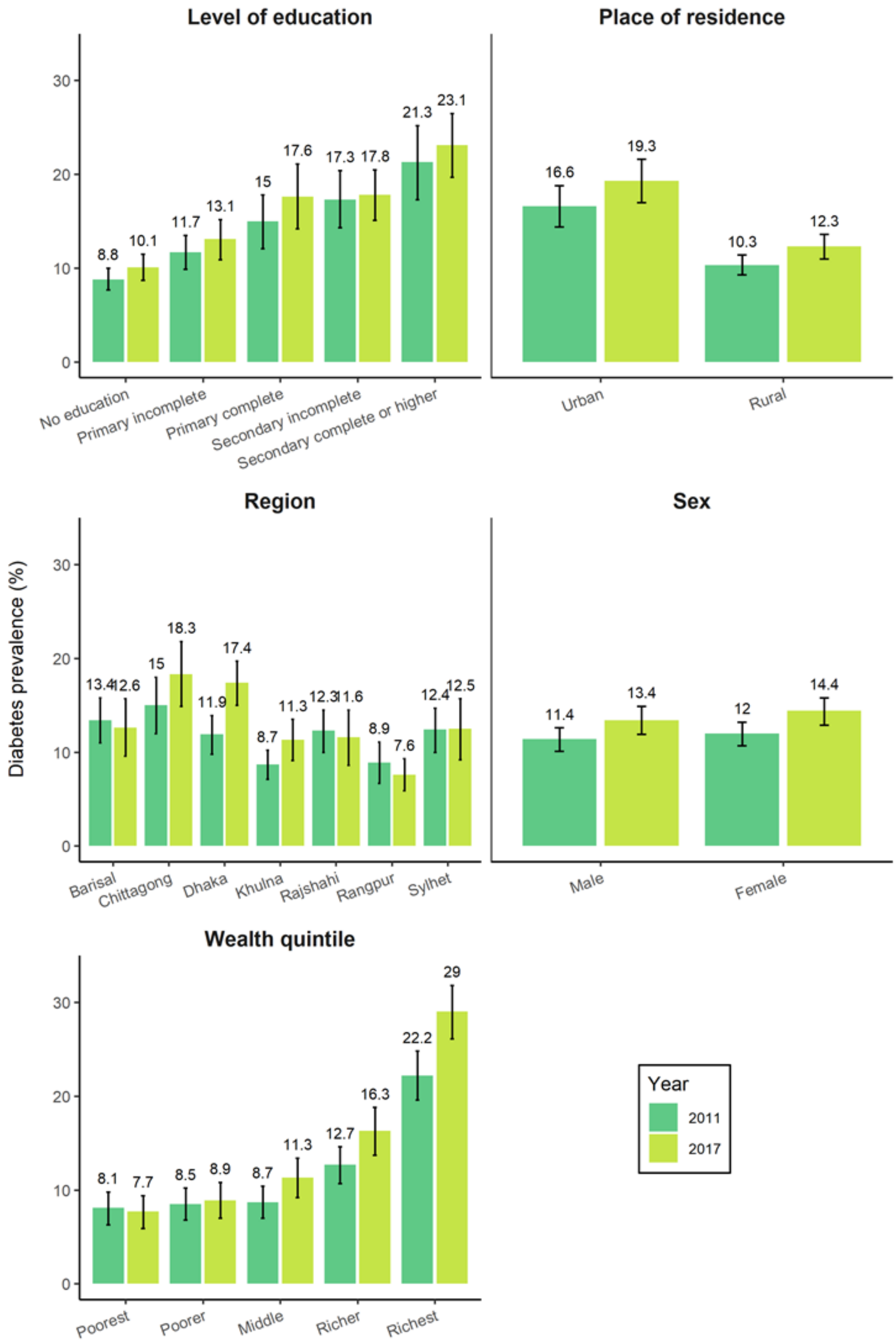

Figure 1. Diabetes prevalence in 2011 and in 2017/2018 across socioeconomic and geographic groups

Predicted diabetes prevalence using logistic regression models with age (b-splines with three interior knots), sex, BMI and an interaction term between the survey year and the respective grouping variable as predictors. The horizontal error bars represent 95% confidence intervals based on bootstrapping. Dhaka includes observations from the new administrative division Mymensingh, which was formed in 2015.

Potential drivers of the national rise in diabetes prevalence

Figure 2 compares the observed change in the prevalence of diabetes from 2011 to 2017/18 to the change that would have been expected had the potential driver of the change (age, BMI, urbanization, and household wealth) remained constant at its 2011 level. Using this approach, the strongest driver of the increase in diabetes prevalence from 2011 to 2017/18 was BMI. In fact, virtually the entire increase in the prevalence of diabetes from 2011 to 2017/18 can be attributed to changes in BMI. If mean BMI had remained the same between 2011 and 2017/2018, diabetes prevalence would have only increased by 0·1 percentage points (95% CI: -1·2 – 1·4). We also identified an increase in household wealth as an important potential driver of the rise in diabetes prevalence between the two surveys. If household dwelling characteristics and ownership of durable goods had remained the same between 2011 and 2017/18, the rise in the prevalence of diabetes would have only been 0·7 percentage points (95% CI: -0·5 – 2·0). The contribution of household wealth to rising diabetes prevalence was, however, limited to rural areas (Figure S3 in the appendix).

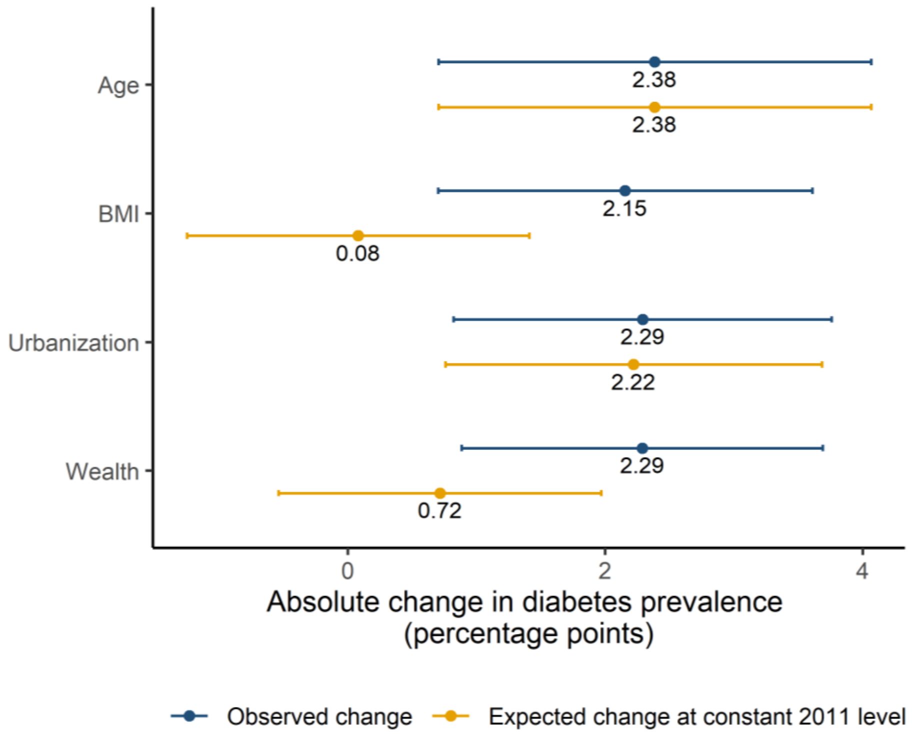

Figure 2. Observed change in diabetes prevalence versus the expected change if the potential driver had remained constant between 2011 and 2017/18

Predicted absolute change in diabetes prevalence using logistic regression models with age, sex, the survey year, and the respective driver as predictors. The horizontal error bars represent 95% confidence intervals based on bootstrapping. While the dark blue estimates show the factual change predicted with the values observed in each year, the estimates in light blue show the counterfactual changes net of changes in the considered driver (i.e. holding age, BMI, urbanization, or household wealth at the level from 2011).

BMI as a driver of rising diabetes prevalence in Bangladesh

Among those aged 35 years and older, mean BMI increased from 20·9 $\frac{kg}{m^2}$ (95%CI: 20·8 – 21·1) in 2011 to 22·5 $\frac{kg}{m^2}$ (95% CI: 22·4 – 22·7) in 2017/18. Using Asia-specific cutoffs, the percent who were overweight or obese rose from 63·1% (95% CI: 61·5 – 64·6) in 2011 to 77·5% (95% CI: 76·0 – 78·9) in 2017/18. Similarly, the percent who were obese increased from 19·9% (95% CI: 18·6 – 21·2) in 2011 to 34·8% (95% CI: 33·2 – 36·4) in 2017/2018.

The large increase in BMI and obesity prevalence from 2011 to 2017/18 affected all considered subpopulations (Figure 3). Across all sociodemographic groups and regions, the smallest increase in obesity prevalence between 2011 and 2017/18 (which took place in the region Sylhet) was still 8·3 percentage points (2011: 18·6% [95% CI: 14·8 – 22·5]; 2017/2018: 27·0% [95% CI: 23·0 – 31·0]) (Figure 3, Panel B). The absolute increases in BMI and obesity prevalence between these years were larger among women than men and in rural than urban areas (Figure S3). In addition, those in higher household wealth quintiles experienced larger absolute increases in obesity prevalence and BMI than those in poorer quintiles. The largest increase in obesity occurred in the regions Dhaka, Chittagong, Barisal, and Khulna.

In absolute terms, BMI was a stronger driver of increasing diabetes prevalence from 2011 to 2017/2018 among higher than poorer household wealth quintiles, and among women than men (Figure 4). Regionally, the largest difference in the absolute change in diabetes prevalence between the observed and the counterfactual (holding BMI constant at its 2011 level) scenario was seen in Dhaka, Chittagong, Barisal, and Khulna.

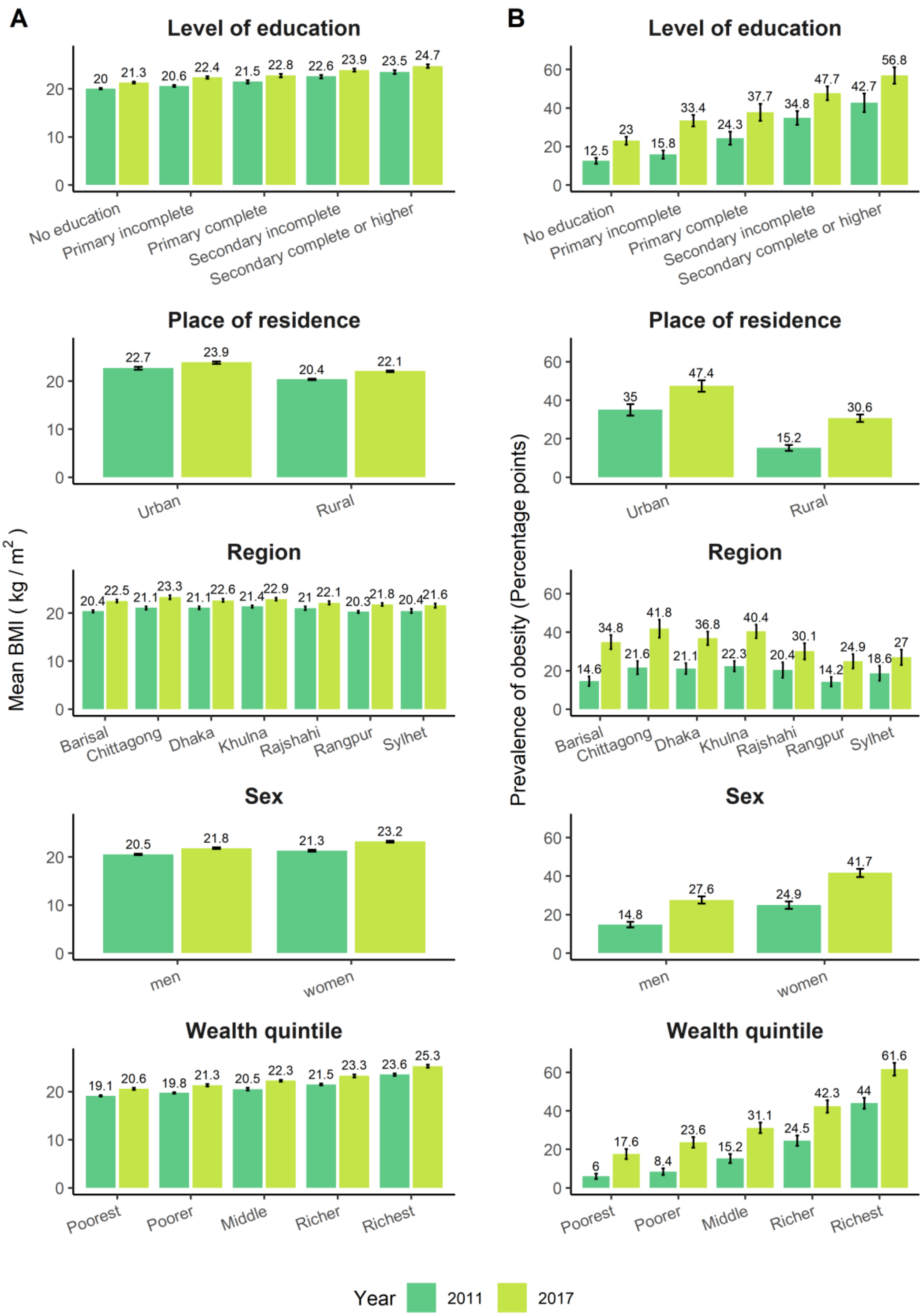

Figure 3. Mean BMI and obesity prevalence in 2011 and in 2017/2018 across socioeconomic and geographic groups

The vertical error bars represent 95% confidence intervals, which account for the complex survey design (through Taylor series linearization). Dhaka includes observations from the new administrative division Mymensingh, which was formed in 2015.

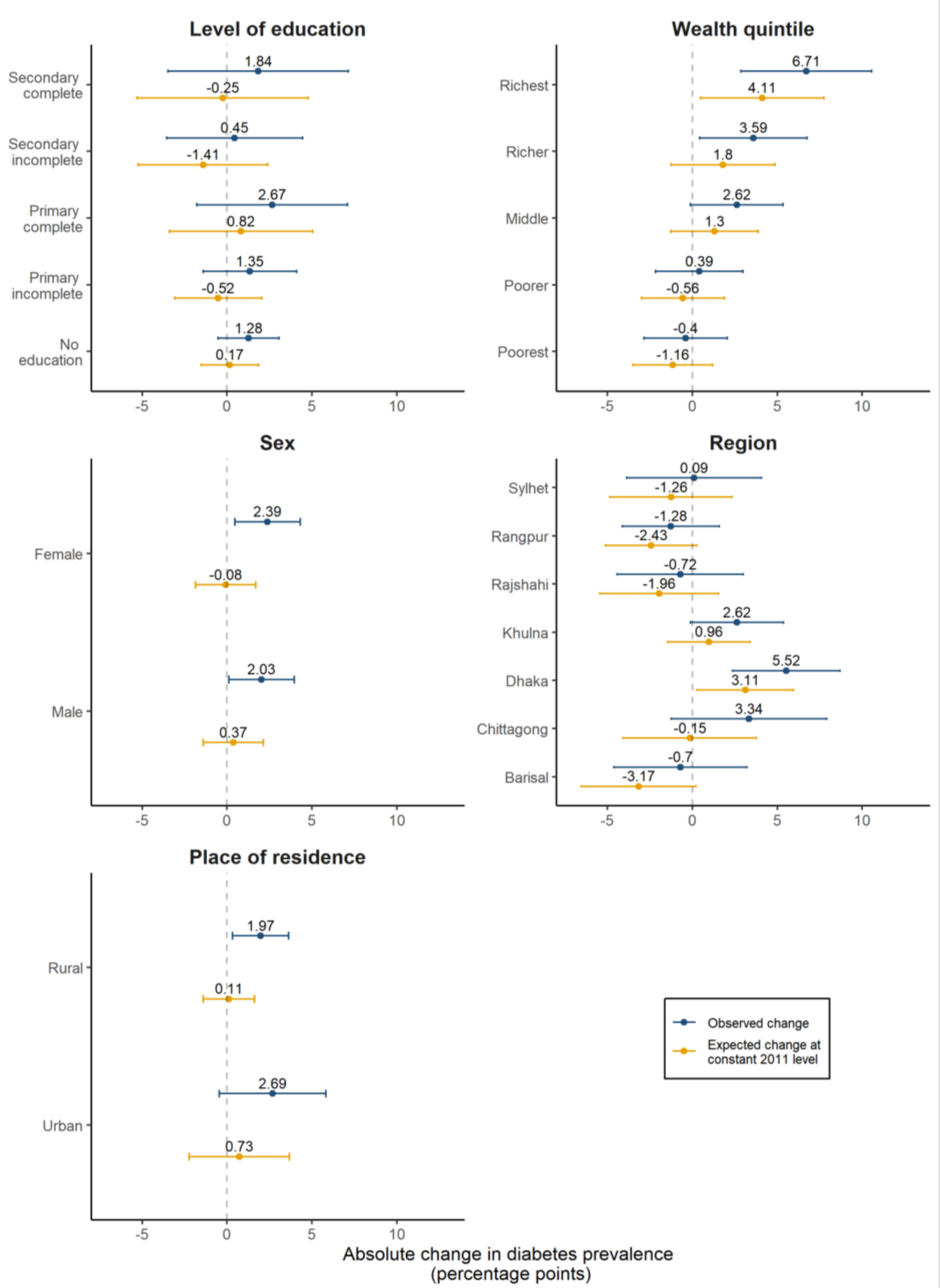

Figure 4. Absolute change in diabetes prevalence across socioeconomic and geographic groups

Predicted absolute change in the prevalence of diabetes using logistic regression models with age (b-splines with three interior knots), sex, BMI and an interaction term between the survey year and the respective grouping variable as predictors. The horizontal error bars represent 95% confidence intervals based on bootstrapping. While the dark blue estimates show the real change predicted with the BMI values observed in each year, the estimates in light blue show the counterfactual changes net of changes in BMI (i.e. holding BMI at its 2011 level). Dhaka includes observations from the new administrative division Mymensingh, which was formed in 2015.

Robustness and sensitivity analyses

Our results remained qualitatively similar when holding the share of the population with obesity (instead of mean BMI) at the level from 2011 to calculate the counterfactual national change in the prevalence of diabetes (appendix Figure S2). We also repeated our subgroup analyses with the household wealth quintiles computed by the DHS team (appendix Figure S4), and with regression models with natural splines for age with four degrees of freedom instead of b-splines (appendix Figure S6). These methodological changes did not change our conclusions.

Discussion

The prevalence of diabetes among adults aged 35 years and older in Bangladesh increased substantially in less than 7 years. We found that several subpopulations were disproportionately affected by this rising burden: the wealthiest 60% of the population, three regions (particularly Dhaka), people with completed primary or secondary education, urbanized areas and – to a lesser extent – women. As most of these population groups already had a higher diabetes prevalence in 2011 than other groups, socioeconomic and geographic differences in the prevalence of diabetes increased over time. The rising burden of diabetes in Bangladesh was paralleled by an even more pronounced rise in unhealthy weight: Mean BMI, the prevalence of being overweight or obese, and the prevalence of obesity all increased dramatically within the span of just seven years. For instance, obesity prevalence rose by almost three quarters from approximately 20% in 2011 to 35% in 2017/18. Importantly, this rapid rise in body weight took place across all subpopulations. Our counterfactual analysis estimates that this increase in body weight likely is the major driver of the rise in diabetes prevalence in Bangladesh across all affected socioeconomic and geographic groups, and particularly so among women and those living in wealthier households. While we also found that increasing household wealth was an important contributor to rising diabetes prevalence, much of this effect may be due to the strong positive association between household wealth and BMI.

The rise in diabetes prevalence we found is cause for concern. Assuming a continued linear trend, our results indicate that the prevalence of diabetes in Bangladesh among adults aged 35 years and older would reach more than 18% by 2030. This would be higher than the current prevalence in Europe (8·9%) and the United States (13·3%) among adults aged 20 to 79 years.[1] In contrast to this, a recent modeling study projected a diabetes prevalence of just 11% in the age group 20-79 by 2030 in case of continued past diabetes trends and expected demographic changes.[25] Our data, however, show that the diabetes prevalence in Bangladesh among adults above 18 years of age already exceeded this number in 2017/2018.[26]

According to a pooled analysis of population-based studies from 2016, the rise in mean BMI flattened in most high-income countries after the year 2000 compared with the preceding 25 years, while South and Southeast Asian countries have been confronted with an accelerating upward trends since the new millennium.[27] Our study, however, suggests that the magnitude of this increase may be substantially higher than previously thought. Based on complex geospatial modeling, the NCD Risk Factor Collaboration has estimated that mean BMI in Bangladesh among those aged 18 years and older increased from 21·1 $\frac{kg}{m^2}$ (95% CI: 20·7 – 21·5) to 21·4 $\frac{kg}{m^2}$ (95% CI: 20·8 – 22·0) in men and from 21·4 $\frac{kg}{m^2}$ (95% CI: 21·0 – 21·8) to 22·1 $\frac{kg}{m^2}$ (95% CI: 21·4 – 22·7) in women between 2011 and 2016, respectively.[27,28] Our empirical analysis of nationally representative survey data finds a much higher increase from 2011 to 2017/2018 for a similar age group: Between 2011 and 2017/2018, BMI among those aged 20 years and older increased from 20·6 $\frac{kg}{m^2}$ (95% CI: 20·5 – 20·7) to 21·8 $\frac{kg}{m^2}$ (95% CI: 21·7 – 22·0) in men and from 21·4 $\frac{kg}{m^2}$ (95% CI: 21·3 – 21·5) to 23·2 $\frac{kg}{m^2}$ (95% CI: 23·1 – 23·3) in women (the estimates for 2011 do not include never-married women and men in the age group 20-34, as their BMI was not measured in the first survey). Importantly, increasing BMI was not just the result of reduced undernutrition but to a large extent driven by an alarming rise in the proportion of the population with overweight and overweight or obesity. In spite of the key role of obesity as a likely driver of rising diabetes in Bangladesh, the residual share of the change in diabetes prevalence beyond the contribution of BMI was also considerable in some subpopulations. For instance, we estimated that even net of the change that was attributable to BMI, the prevalence of diabetes increased by 3·11 percentage points (95% CI: 0·26 – 5·96) in the region of Dhaka.

In line with our results, a recent systematic review found that higher SES as measured by education, income, and household wealth was associated with higher diabetes prevalence in low-income and lower middle-income countries.[29] The nutrition transition theory, according to which wealthier segments of the population in LMICs adopt unhealthy eating habits observed in industrialized countries first, has been put forward as a potential explanation for this gradient.[30] High-income countries are typically characterized by a negative association between diabetes (as well as other cardiovascular disease risk factors) and SES, such that it has been hypothesized that those in lower SES groups in LMICs will catch up and eventually have a higher diabetes prevalence than those in higher SES groups as countries develop economically.[29] Recent studies found some evidence for this hypothesis in the context of India.[31,32] However, our results do not indicate that a similar process of reversal in the socioeconomic gradient for diabetes has started in Bangladesh. Rather, the difference in diabetes prevalence between low and high SES groups (at least when SES is measured through household wealth) appears to have increased over the past decade.

The key strength of this study is that it is the first analysis of repeated and nationally representative data with biomarker-defined diabetes in South Asia. As such, this study is unique in being able to empirically examine trends in the prevalence of diabetes at the national level, how these vary across socio-demographic groups, and which factors likely are the key drivers of the rising diabetes prevalence at the population level. Cohort studies, on the other hand, are only able to examine risk factors for diabetes at the individual, rather than population-wide, level. Nonetheless, this study also has several limitations. First, given the repeated cross-sectional nature of the data, we are unable to rule out important confounding. Still, we believe that the main conclusions of our counterfactual analysis are not driven by major confounding due to the simultaneous stark rise in diabetes and obesity prevalence, the strong correlation between population subgroups that experienced the largest increase in diabetes and those with the largest increase in obesity, as well as the well-established relationship between obesity and diabetes.[16,17,33] Second, diabetes was defined based on a one-off fasting plasma glucose measurement rather than repeated measurements. However, while this limitation may have affected our estimates of the level of diabetes prevalence in a given survey, it is unlikely to have had a major bearing on our analysis of trends over time given that the definition of diabetes and the measurement of fasting plasma glucose were consistent in both surveys. Third, whether or not a participant was fasted at the time of the plasma glucose measurement was verified by self-report only. It is, thus, plausible that some participants may have stated that they are fasted (e.g., to appear in agreement with the instructions given by the survey team) although they were not. However, unless the probability to falsely report being fasted varied across surveys, this limitation likely did not affect our findings on trends over time. Lastly, 17·4% of our sample were excluded from the analysis because of missing information on diabetes or BMI, which may have introduced bias.

In conclusion, the recent increase in the prevalence of diabetes among adults in Bangladesh is likely driven by an alarmingly rapid rise in overweight and obesity across all sociodemographic groups in the country. We found that the magnitude of this increase in body weight was substantially larger than previously estimated. Major structural changes to cities and environments that encourage physical activity and healthier diets are needed to prevent further increases in unhealthy weight, particularly in disproportionally affected subpopulations. These policy level changes, constitute a crucial leverage point to halt, or at least substantially mitigate, the diabetes epidemic in Bangladesh and likely South Asia more generally.

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