

# BMJ Open Prevalence of multimorbidity among Bangladeshi adult population: a nationwide cross-sectional study

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## ABSTRACT

**Objective** This study aimed to report prevalence and evaluate the association between multimorbidity and associated risk factors in the adult population of Bangladesh.

**Design** A cross-sectional study was conducted using a multistage clustered random sampling strategy.

**Setting** The study was conducted among the general population of 58 districts in Bangladesh.

**Participants** A total of 12 338 male and female individuals aged  $\geq 35$  were included for analysis in this study. Identified through a household listing conducted prior to the study, from 15 297 individuals meeting the inclusion criteria, 12 338 participants were included based on availability during data collection, consent and health condition.

**Outcome measures** Multimorbidity in terms of hypertension, diabetes, cancer, cardiovascular diseases, stroke and chronic obstructive pulmonary disease.

**Results** Approximately 8.4% (95% CI 7.0 to 9.7) of individuals suffer from multimorbidity, of which hypertension accounted for (30.1%) followed by diabetes (10.6%). The mean age of the population was 58.6 (SD  $\pm 9.2$ ) years. The prevalence of multimorbidity was lower among men (7.7%) compared with women (8.9%). The likelihood of having multimorbidity among obese individuals were more than double than people with normal body mass index (BMI). Physical activity protected individuals from developing multimorbidity: however, the physical activity adjusted OR was 0.5 (95% CI 0.2 to 1.2). After adjusting for all covariates, higher age, higher educational status, economic status, and higher BMI were found to be significantly associated with the odds of developing multimorbidity, with an overall adjusted OR of 0.02 (95% CI 0.01 to 0.02).

**Conclusion** This study reported a high prevalence of multimorbidity in Bangladesh, although it explored the burden and identified risk factors considering only six chronic diseases. Further detailed exploration through longitudinal studies considering a wider range of diseases is needed to document the actual burden, develop effective preventive measures and clinical guidelines to improve the quality of life of the population.

## INTRODUCTION

Multimorbidity is becoming an emergent global health concern. It is commonly defined as the presence of two or more

## Strengths and limitations of this study

- First large-scale national-level study in Bangladesh reporting the prevalence of multimorbidity with rural and urban area coverage. It also reports the current national-level prevalence of major chronic diseases.
- The study relied on the self-reported chronic disease data and also cross-checked prescriptions written by registered physicians.
- While the study collected and analysed data at the national level, the rural sample is over-represented.
- We took into account only six major predetermined chronic diseases; understandably, when considering the full range of possible diseases, the proportion would be higher.
- Given its cross-sectional design, the study cannot demonstrate a causal relationship, only association.

chronic diseases in an individual.<sup>1</sup> Multimorbidity presents several challenges to any healthcare system since most are generally focused on treating single diseases rather than multiple coexisting conditions. More common among the elderly population, the growing demand for healthcare needs to deal with multiple non-communicable diseases/multimorbidity and associated poly-pharmacy is putting considerable strain on healthcare systems around the world.<sup>2</sup> This certainly adds to the already challenging burden of addressing chronic diseases. At the patient level, coexisting multiple diseases in an individual increase financial constraints and also complicate life in various ways—the decreasing quality of life and productivity, adherence to complex medication regimens, multiple specialised healthcare needs and often massive changes in lifestyle.

Multimorbidity adversely affects the health and well-being of the individual in many ways. First, it leads to lower disability-adjusted life years. Patients suffering from multimorbidity have a high treatment burden in terms of understanding and self-managing diseases.<sup>3</sup> Second, it is associated with decreased quality of life and increased healthcare utilisation,

including higher incidences of emergency admissions and referral points. Third, the management of multimorbidity with drugs is often complex, resulting in polypharmacy and its associated risks.<sup>4</sup> This includes primary and secondary care outpatient visits and often multiple hospital admissions. Patients from lower socioeconomic groups are generally even more burdened given the high financial costs of dealing with long-term diseases. In health system aspect, managing patients with multimorbidity overall is found to be taxing for the patients and also for practitioners because of complex regimens, multiple entry points and referrals.<sup>4-7</sup> As a result, there is a growing consensus that the increasing prevalence of multimorbidity is likely to put challenges on healthcare systems and ultimately healthcare costs, making poor people even poorer.<sup>8</sup>

Mounting evidence suggests that sociodemographic factors are associated with multimorbidity.<sup>9</sup> Furthermore, different studies have found lifestyle factors including smoking, obesity, unhealthy diet and alcohol to be linked with multimorbidity as well.<sup>9 10</sup> Most of the studies and guidelines on the management of long-term conditions have traditionally been focused on single diseases rather than multimorbidity. Evidence on population-based estimates and risk factors of multimorbidity are also not readily available globally, which makes future planning a challenge.<sup>6</sup>

So far, most of the population-based studies adopted the WHO-recommended definition of multimorbidity—‘coexisting multiple chronic diseases in an individual’ to quantify multimorbidity burden, although a list of recommended diseases has not been specified.<sup>1</sup> A large-scale study in Canada documented that the prevalence of multimorbidity among Ontarians rose from 17.4% in 2003 to 24.3% in 2009, denoting a 40% escalation. This increase over time was evident across all age groups. Another study in Catalonia, Spain reported that, when all chronic conditions were included in the analysis, almost 50% of the adult urban population had multimorbidity.<sup>11-13</sup> In Portugal, multimorbidity was present in 72.7% of the population. In China, the prevalence is found to be above 50% in the elderly population.<sup>14</sup> In the UK, the number of people with three or more long-term conditions is estimated to have risen from 1.9 million in 2008 to 2.9 million in 2018.<sup>9</sup> This wide variation in terms of reported prevalence is mainly due to the number of diseases included in the measurement of multimorbidity.

Multimorbidity is a growing area of research in the western world, but there is limited evidence on the burden among developing countries. South Asians have already been characterised as an inherently high-risk group for developing cardio-metabolic and other chronic diseases, and thus multimorbidity is thought to be significantly prevalent in these populations.<sup>2</sup> Bangladesh, being a developing country in South-East Asia and struggling with the double burden of infectious as well as non-communicable diseases (NCDs), has not yet addressed this health issue at the national level, although it can be a challenge for the

healthcare system in near future, given the rising size of older populations. There is also very limited documentation on the status of multimorbidity, with no nationally representative large-scale data. Many chronic conditions lead to a multimorbid status associated with increasing age. As per the WHO Non-Communicable Disease (NCD) Report 2011, more than 52% of deaths in Bangladesh are caused by different NCDs and more than 27% are due to cardiovascular causes. In the NCD risk factors survey conducted in 2010 by the Ministry of Health and Family Welfare, almost 99% of the Bangladeshi population had at least one NCD risk factor; out of those, 29% had three or more risk factors. A recent study projected that by 2025, the death rate from cardiovascular diseases will increase 21 times.<sup>15</sup> This evidence denotes the importance of NCDs in Bangladesh healthcare planning. While a study on the rural elderly population reported a 53.7% prevalence of multimorbidity in Bangladesh,<sup>16</sup> a large-scale nationally representative study is of great importance to generate evidence on current status (prevalence, incidence and risk factors). Therefore, the purpose of our study was to capture the current burden and risk factors of multimorbidity in Bangladesh including participants from a wider age group ( $\geq 35$  years).

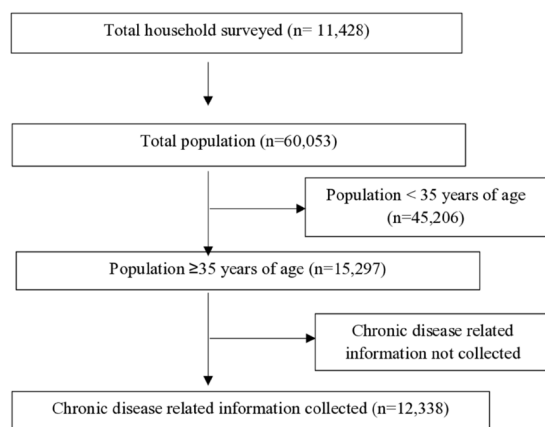
## METHODOLOGY

BRAC (Building Resources Across Communities), the world's number 1 non-government organisation, has been a pioneer in its health initiatives since its inception. Through its flagship health intervention, health nutrition and population programme (HNPP), it has come up with a comprehensive healthcare package to assist the vulnerable population of the country at an affordable cost. A large-scale cross-sectional study was conducted in 2014 to explore the status of selected healthcare indicators (in line with the Strategic Partnership Arrangement of BRAC) in HNPP working areas of BRAC. Information on NCDs as well as chronic diseases and multimorbidity was extremely important, as NCD status exploration was one of the key focus. The data were collected from a nationwide sample covering both rural and urban areas.

## Study design and population

The cross-sectional study was conducted using a multi-stage clustered random sampling strategy. Details about the data collection process can be found elsewhere.<sup>17</sup> Put briefly, we collected information from 11 428 households, with a response rate of 94.9%. In the first stage of sampling, 210 enumeration areas (EAs) were selected randomly with probability proportional to EA size. This included 180 EAs from rural areas and 30 EAs from urban slums. An EA is a union (rural areas) or ward (urban slums)—the lowest administrative unit in Bangladesh. A union is defined as a collection of a small number of villages, whereas a ward is typically a collection of villages and/or slums. A slum is defined as a cluster of compact settlements of five or more households. A complete list of

Respondent selection:



**Figure 1** Study participant selection.

unions and wards was included in the sampling frame for the first stage of sampling, which was collected from the most recent Population and Housing Census of Bangladesh.<sup>18</sup> In the second stage of sampling, starting from the north-west corner of an EA with a systematic random sample of five households, an average of 54 households per EA were selected to provide statistically reliable estimates for rural areas and urban slums separately. Information was collected from all the men and women aged  $\geq 35$  years residing in the selected households, with 80.9% complete responses (figure 1).

### Data collection procedures and tools

Recruitment of respondents for the study required the creation of a study base for systematic sampling based on demographic characteristics and BRAC programme interventions. To recruit eligible survey respondents from the household census, eligible respondents (willing to participate, not critically ill and  $< 35$  years old) were identified. The household census was carried out using a structured questionnaire between 22 August and 5 September 2015. Individual data were collected from 11 October 2015 to 6 January 2016 through face-to-face interviews with a pre-tested structured questionnaire from 58 out of 64 districts in Bangladesh. The questionnaire was installed in tablet personal computers using open data kit (ODK V.1.4.5) software; data collection was carried out by trained interviewers (figure 1).

The required sample size was calculated for an observed rate, associated margins of error (5%) and a non-response rate. A sample size of 15 297 was found to be sufficient. The sample size was calculated considering a 5% statistical significance and a design effect of 1.5% and 5% non-response rate. Among them, 12 338 people provided anthropometric measurements, and their blood pressure and urinary glucose were assessed. Chronic disease data were self-reported, and prescription verified by trained enumerators.

A detailed questionnaire was developed, and the tool was pre-tested (150 samples) in both rural and urban

areas by trained enumerators before the commencement of the study. A thorough review by the lead researchers resulted in required modifications of the questions. A total of 110 skilled interviewers (with prior experience in conducting large-scale healthcare surveys) were recruited for data collection.

Respondents were ensured of the confidentiality of any information provided. The respondents were informed that they had the full right to withdraw their participation at any time during the interview. Data were stored in BRAC head office servers to which only the researchers of the group had access. Critically ill patients were excluded from the study.

### Measurement of variables

The primary outcome variable for this study is multimorbidity, which is when an individual suffers from two or more of the following NCDs: hypertension, diabetes, chronic obstructive pulmonary disease (COPD), cancer, heart diseases and stroke. At first, history was taken from the participants. Later, prescriptions were checked for validity of diagnosis by a registered physician. To measure the presence of hypertension, we included respondents who were previously diagnosed by a registered doctor, were taking anti-hypertensive medication or were found to be hypertensive (systolic  $\geq 140$  mmHg or diastolic  $\geq 90$  mmHg) by measurement of blood pressure at the time of the interview. For diabetes, we included people who had been diagnosed by doctors as diabetic, were on medication or tested positive on a urinary strip test at the time of interview. Other diseases were confirmed by asking the respondents whether they had been diagnosed by a registered physician, as well as by checking the available prescriptions.

The list of potential risk factors of multimorbidity was based on literature about the risk factors of different chronic diseases. The assumption was that that the risk factors will be similar for multiple chronic diseases combined. These include sociodemographic characteristics (age, sex, educational status and economic status), as well as health and lifestyle-related factors (physical (in) activity, obesity, tobacco use, sleeping habit and dietary diversity).<sup>7,9</sup> These data were collected through face-to-face interviews with respondents using a questionnaire. Variables BMI (underweight,  $< 18.5$  kg/m<sup>2</sup>; normal, 18.5–24.9 kg/m<sup>2</sup>; overweight, 25.0–29.9 kg/m<sup>2</sup>; obese,  $\geq 30.0$  kg/m<sup>2</sup>) and hypertension were categorised and calculated using standardised WHO guidelines. Daily sleeping time of the participants was measured by the standard average sleeping hour of 8 hours as per participant history taking.

### Statistical analysis

We first estimated the prevalence of multimorbidity in the study population using descriptive statistics. Distributions of potential risk factors were compared between respondents with and without multimorbidity using t-tests for continuous variables and  $\chi^2$  test of independence for

**Table 1** Prevalence of chronic diseases individually and clusters

Variable	Prevalence (n=12338) n (%)
Hypertension	3754 (30.1)
Diabetes	1310 (10.6)
Cardiovascular diseases (CVDs)	391 (3.1)
Cancer	15 (0.1)
Stroke	219 (1.8)
Chronic obstructive pulmonary disease (COPD)	116 (0.9)
Having only one physical condition	3534 (28.7)
Multimorbidity (having two or more physical conditions)	1031 (8.4)
Hypertension, diabetes, CVDs	76 (0.6)
Hypertension, diabetes, stroke	45 (0.4)
Hypertension, diabetes, cancer	1 (0.0)
Hypertension, diabetes, COPD	14 (0.1)
Hypertension, CVDs, stroke	40 (0.3)
Diabetes, CVDs, stroke	21 (0.2)
Hypertension, diabetes, CVDs, stroke	18 (0.6)

categorical variables. The association between potential risk factors and multimorbidity was estimated by crude and adjusted ORs using bi-variate and multivariate logistic regression models respectively. We used 'robust' option to adjust for complex sampling design. An association was considered significant if p value was <0.05. Crude OR was used to identify the association of each of the independent variables while the adjusted OR (adjusted for confounding considering sociodemographic and lifestyle factors such as age, sex, BMI, physical activity, fruit, and fish and meat intake) identified the association of individual factors with the outcome measurement p value <0.05. The fitness of the final model was tested using Hosmer-Lemeshow goodness-of-fit test (p value was not significant). All analyses were done using STATA V.12.<sup>19</sup>

### Patient and public involvement

No patient was involved in this study. They were recruited after the initial household census. They were not involved with the study design, recruitment or conduction of the study. Consent was received for further publication. We are thankful for their consent, participation and co-operation.

### RESULTS

**Table 1** illustrates the prevalence of chronic diseases individually and in clusters. The prevalence of individual diseases among study participants was as follows: hypertension, 30.1%; diabetes, 10.6%; cardiac diseases, 3.2%; stroke, 1.8%; COPD, 0.9%; cancer, 0.2%. More than 60%

of patients with diagnosed cardiovascular disease, cancer, stroke and COPD were on regular medication. In terms of multimorbidity, 8.4% of the study population presented two or more of the aforementioned diseases.

We next explored the association between multimorbidity and different demographic variables, as well as other risk factors (**table 2**). The mean age of individuals suffering from multimorbidity is 58.5 years. Women present a higher prevalence of multimorbidity than men (8.9% vs 7.7%, p=0.021). The probability of multimorbidity among tobacco users or people who take extra salt with food is around 8.1%.

In **table 3**, we show how, within the study population, older people and women are significantly at higher odds of developing multimorbidity both in the crude and adjusted model. People belonging to the top two wealth quintiles and with higher educational status have a significantly higher probability of having developed multimorbidity than poorer and less educated respondents. Odds of multimorbidity in people with higher BMI ( $\geq 25$ ) were 2.10 times the odds in people with normal BMI. The OR comparing physically active people with those who are not active at all is 0.5 (95% CI 0.2 to 1.3).

### DISCUSSION

Multimorbidity is a less explored area in healthcare research compared with individual diseases, which are typically explored both clinically and epidemiologically. The recent Sustainable Development Goals (SDGs) suggest that the post-2015 agenda will be substantially influenced by a focus on 'health in all ages', including Target 3.8 which aims to achieve universal health coverage. The realisation of these goals and other wider development targets will require multiple morbidities to be addressed.<sup>20</sup> Therefore, with an increasing burden of chronic diseases worldwide, individuals suffering from multiple chronic diseases are also emerging as a healthcare priority.<sup>1 11</sup> This is the first study (to our knowledge) reporting multimorbidity burden in Bangladesh conducted both in urban and rural areas, although results cannot be compared as there has not yet been any other large-scale study among the general population nor any systematic review or meta-analysis on the entire South Asia reporting the pooled prevalence and risk factors. Prevalence of multimorbidity (8.4%) counted within only six diseases is quite high. We adopted the commonly used WHO definition, but the lack of data on a similar context and a similar population, as well as the absence of a consensual definition, make our findings less comparable. As we used appropriate sampling methods and/or calculation, our large population-based cross-sectional data were powerful enough to calculate the prevalence of chronic diseases and multimorbidity prevalence among the Bangladeshi population. A study such as this one contributes to generate evidence and inform healthcare policy-makers for timely action and preparedness.

**Table 2** Relationship of multimorbidity with demographic variables

Variable	Category	Multimorbidity		P value
		No n=11 307 (91.7%)	Yes n=1031 (8.4%)	
Age (mean, SD)		51.1 (12.8)	58.6 (13.0)	<0.001*
	Male	50.5 (13.6)	61.1 (13.1)	<0.001*
	Female	51.7 (12.0)	56.5 (11.8)	<0.001*
Age (n, %)	35–40	3424 (97.2)	100 (2.8)	<0.001*
	41–50	2842 (92.3)	237 (7.7)	
	51–60	2728 (90.6)	288 (9.6)	
	>60	2313 (85.1)	406 (14.9)	
Sex (n, %)	Male	5531 (92.3)	464 (7.7)	0.021*
	Female	5776 (91.1)	567 (8.1)	
Marital status (n, %)	Married	9385 (92.2)	789 (7.8)	<0.001*
	Unmarried	68 (93.6)	5 (6.9)	
	Currently single	1854 (88.7)	237 (11.3)	
Wealth quintile (n, %)	Poorest	2354 (95.3)	115 (4.7)	<0.001*
	Second	2358 (94.3)	141 (5.6)	
	Middle	2346 (93.1)	175 (6.9)	
	Fourth	2209 (90.1)	244 (9.1)	
	Richest	2040 (85.1)	356 (14.9)	
Educational status (n, %)	No education	6992 (92.8)	541 (7.2)	<0.001*
	Primary education	2397 (91.0)	237 (9.0)	
	Secondary and higher	1918 (88.3)	253 (11.7)	
BMI (mean, SD)		21.67 (3.6)	23.49 (4.3)	<0.001*
BMI (n, %)	18.5–25 kg/m <sup>2</sup>	7137 (92.9)	548 (7.1)	<0.001*
	<18.5 kg/m <sup>2</sup>	2083 (94.1)	110 (5.0)	
	≥25 kg/m <sup>2</sup>	1863 (84.1)	350 (15.8)	
Unhealthy lifestyle habit (tobacco, smokeless tobacco, extra salt intake) (n, %)	Yes	10 653 (91.9)	936 (8.1)	<0.001*
	No	654 (87.3)	95 (12.7)	
Average days of fish/meat intake (weekly)	Less than 4 times per week (n, %)	2979 (93.1)	191 (6.0)	<0.001*
	4 or more times per week (n, %)	8328 (90.8)	840 (9.2)	
Average days of fruit intake (weekly)	Less than 4 times per week (n, %)	10 536 (92.2)	892 (7.8)	<0.001*
	4 or more times per week (n, %)	771 (84.7)	139 (15.3)	
Physical activity	Not active (<1 hour)	3154 (90.9)	316 (9.1)	<0.001*
	Less active (1 to less than 3 hours)	7919 (91.8)	709 (8.2)	
	Moderately to highly active (≥3 hours)	234 (97.5)	6 (2.5)	
Sleeping time in last 24 hours	<8 hours	3178 (90.3)	340 (9.7)	<0.001*
	≥8 hours	8129 (92.2)	691 (7.8)	

\* $\chi^2$  test significant p value  $\leq 0.05$ .

BMI, body mass index.

**Table 3** Crude and adjusted OR for the risk factors associated with multimorbidity

Variable	cOR 95% CI	aOR	P value	95% CI
Constant		0.02	<0.001*	0.01 to 0.02
Age				
35–40	1.0	1.0		
41–50	2.8 2.2 to 3.6	3.3	<0.001*	2.6 to 4.3
51–60	3.6 2.9 to 4.5	4.9	<0.001*	3.8 to 6.2
>60	5.1 4.8 to 7.5	8.7	<0.001*	6.8 to 11.1
Sex				
Male	1.0	1.0		
Female	1.2 1.0 to 1.3	1.2	0.003*	1.1 to 1.4
Wealth quintile				
Poorest	1.0	1.0		
Second	1.2 0.9 to 1.6	1.1	0.561	0.8 to 1.4
Middle	1.5 1.2 to 1.1	1.2	0.153	0.9 to 1.5
Fourth	2.3 1.8 to 2.9	1.5	0.002*	1.2 to 1.9
Richest	3.6 2.9 to 4.4	2.1	<0.001*	1.6 to 2.7
Educational status				
No education	1.00	1.00		
Primary education	1.9 1.1 to 1.5	1.5	<0.001*	1.3 to 1.8
Secondary and higher	1.7 1.5 to 2.0	1.8	<0.001*	1.6 to 2.3
BMI				
18.5–25	1.0	1.0		
<18.5	0.9 0.6 to 0.8	0.6	<0.001*	0.5 to 0.8
≥25	2.4 2.1 to 2.8	2.1	<0.001*	1.8 to 2.5
Average days of meat/fish intake (weekly)				
<4 times	1.0	1.0		
≥4 times	1.6 1.3 to 1.9	0.1	0.980	0.8 to 1.2
Average days of fruit intake (weekly)				
<4 times	1.0	1.0		
≥4 times	2.5 1.8 to 2.6	1.3	0.018*	1.0 to 1.6
Physical activity				
Not active	1.0	1.0		
Less active	0.9 0.8 to 1.0	1.1	0.291	0.9 to 1.3
Moderately to highly active	0.3 0.1 to 0.6	0.5	0.152	0.2 to 1.3

\*Significant p value ≤0.05.

aOR, adjusted OR; cOR, crude OR.

Several studies have been conducted on major NCD status and their risk factors, many of which are assumed to be similar to multimorbidity. Most of the previous studies in the western population have shown that low socioeconomic status and less education are positively and specifically associated with multimorbidity.<sup>2 13</sup> Nevertheless, our study finds the opposite results, which are also statistically significant. For higher educational status, adjusted OR (aOR) was 1.8 (95% CI 1.6 to 2.3), and for the richest wealth quintile, aOR was 2.1 (95% CI 1.6 to 2.7). This

could owe to the fact that, being a lower-middle-income country, people with a higher economic status in Bangladesh have access to more food and education. This is consistent with findings from a recent systematic review, reporting that individuals of low socioeconomic status in low-income and lower-middle-income countries are more likely to consume a less healthy diet (eg, less fruit, vegetables, fish and fibre, but more meat). Whereas, individuals of higher socioeconomic status tend to be more physically inactive, thus increasing the prevalence of NCDs.<sup>21</sup> As we

already know, lifestyle factors are closely associated with chronic diseases and multimorbidity risk. We can therefore say that since people of higher economic status have more access to food and also traditionally live a sedentary lifestyle, this leads them to develop more NCD risk factors and ultimately multimorbidity.<sup>22</sup> Identifying higher age and being female as a significant determinant of multimorbidity is consistent with existing literature.<sup>27</sup>

On the contrary, in developed countries, epidemiological evidence is scarce. South Asians have already been characterised as a genetically high-risk group for developing cardio-metabolic and other chronic diseases, resulting in a higher incidence of multimorbidity within the population.<sup>2</sup> The risk factors of multimorbidity identified in our study are similar to the reported risk factors of individual chronic diseases in various analyses. As in many other studies, BMI showed a significant association with multimorbidity.<sup>7</sup> Dozens of epidemiological studies have reported findings on the association between fruit and vegetable intake on one hand, and the risk of cardiovascular disease and other NCDs on the other.<sup>22 23</sup> Our study also corroborates that a higher intake of fish and meat is significantly associated with multimorbidity in the crude analysis, but not in the adjusted model. Increased intake of fruits and vegetables were found to be protective factors against developing multimorbidity, but after adjusting for covariates, this result was not significant. Among other lifestyle factors, increased physical activity and a higher average daily sleeping time were found to be protective factors against developing multimorbidity.<sup>13 14</sup>

Although most of the evidence on multimorbidity is limited to the elderly population globally, this study is unique in the sense that it covers a wider age range. Our study reports that the odds of developing multimorbidity are higher among those on the older cohort compared with the middle-age group (35–40). Even in the age groups 41–50 and 51–60, the odds of developing multimorbidity are respectively 2.8 and 3.6 times higher than among people under 40 years of age. This suggests that people develop multimorbidity even during active and productive years of life, which can cause excess healthcare costs from earlier years in life. In a context of less developed health infrastructure and of an inadequacy of human resources, this evidence on the burden of multimorbidity in Bangladesh warrants further exploration from various perspectives, including further research as well as the development of policies to tackle the burden. Therefore, population-based data on multimorbidity is an urgent need to get the actual scenario of the burden and further develop strategies to prepare the healthcare systems. Otherwise, with the ageing population and ever-rising chronic disease burden globally, healthcare systems shall not be prepared to tackle this healthcare challenge.

## LIMITATIONS

The study has several noteworthy points, and the findings raise new questions. Markedly, it shows that among 12 338

individuals in Bangladesh, nearly 8.4% were suffering from multimorbidity. This proportion can be considered a lower bound estimate considering we only took into account six pre-determined clinical diseases; without a doubt, when considering the full range of possible diseases, the proportion would be higher.<sup>23</sup> Several potential limitations, however, should also be noted. First, we only considered six diseases, and only hypertension and diabetes data were measured, while the remaining four were self-reported by the respondents based on the previous diagnosis by the physicians, which might include selection biases. Second, the validity of the physician reported diagnosis and laboratory diagnosis should have been explored more precisely for conclusiveness. Third, it would have been desirable to have standard-scale data of physical activity. Without a scaling guideline, comparisons against other findings are not possible. Fourth, our findings only draw on data from those areas in which BRAC has coverage. Since BRAC only covers 80% of the whole population, the results cannot strictly be considered representative of Bangladesh. The rural sample might also be over-represented (93%). Meanwhile, the urban data are generalisable to only the urban slum areas and therefore it may not be wise to generalise for the urban population of Bangladesh; that is, we may be under-reporting the prevalence of multimorbidity among the urban population. A precise nationally representative sampling strategy would have been desirable to report the actual nationally representative data on multimorbidity burden.<sup>13</sup> Fifth, considering the cross-sectional design of our study, the current results do not demonstrate a causal relationship, but rather associations which suggest possible effects. A well-designed cohort study with prospective data is essential to predict mortality and report incidence.<sup>24</sup> Sixth, we have only adjusted for potential confounding variables for which data were available during this cross-sectional study. Lastly, a combination of population-based and hospital-based data would be more representative and might indicate a higher prevalence.<sup>15</sup> Despite its many limitations, the major strength of the study is that we did not rely on self-reported chronic disease data, and instead included those that were diagnosed by a registered physician.

## CONCLUSION

This study identifies the prevalence of multimorbidity among Bangladeshi individuals who are undergoing an epidemiological transition. It is comparable with many developing countries and thus highlights the importance of recognising associated risk factors, especially among young adults and also in the elderly. A prevalence of nearly 9% in a nationwide sample is alarming. The lack of a consensual definition of multimorbidity may also contribute to underestimation or overestimation. We recommend that an international clinical guideline with an approved range of diseases should be developed to serve the purpose, which would also aid in monitoring progress towards the fulfilment of the United Nations'

SDGs. As for Bangladesh, there is a need for a detailed national-level exploration including the rural and urban population in a larger scale to document the current prevalence, incidence and specific risk factors associated with multimorbidity. This would help inform policy-makers and further develop preventive strategies and clinical guidelines.

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