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**Published**

2021

**Journal Title**

BMJ Open

**Version**

Version of Record (VoR)

**DOI**

[10.1136/bmjopen-2020-038954](https://doi.org/10.1136/bmjopen-2020-038954)




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# BMJ Open Prevalence and associated factors of depression among adolescent boys and girls in Bangladesh: findings from a nationwide survey

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**To cite:** Mridha MK, Hossain MM, Khan MSA, *et al.* Prevalence and associated factors of depression among adolescent boys and girls in Bangladesh: findings from a nationwide survey. *BMJ Open* 2021;**11**:e038954. doi:10.1136/bmjopen-2020-038954

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2020-038954>).

Received 30 March 2020  
Revised 07 December 2020  
Accepted 02 January 2021



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## ABSTRACT

**Objective** To assess the prevalence and factors associated with depression among adolescent boys and girls.

**Design** We conducted a nationwide cross-sectional study.

**Setting** This study was carried out in 82 randomly selected clusters (57 rural, 15 non-slum urban and 10 slums) from eight divisions of Bangladesh.

**Participants** We interviewed 4907 adolescent boys and 4949 adolescent girls.

**Primary and secondary outcome measures** The primary outcome measure was 'any depression' and the secondary outcome measures were types of depression: no or minimal, mild, moderate, moderately severe and severe.

**Results** The overall prevalence of no or minimal, mild, moderate, moderately severe and severe depression was 75.5%, 17.9%, 5.4%, 1.1% and 0.1%, respectively. Across most of the sociodemographic, lifestyle and anthropometric strata, the prevalence of any depression was higher among adolescent girls. In both sexes, depression was associated with higher age, higher maternal education, paternal occupation e.g., business, absence of a 6–9-year-old member in the household, food insecurity, household consumption of unfortified oil, household use of non-iodised salt, insufficient physical activity (adjusted odds ratio, AOR: 1.24 for boys, 1.44 for girls) and increased television viewing time e.g., ≥121 minute/day (AOR: 1.95 for boys, 1.99 for girls). Only among boys, depression was also associated with higher paternal education e.g., complete secondary and above (AOR: 1.42), absence of another adolescent member in the household (AOR: 1.34), household use of solid biomass fuel (AOR: 1.39), use of any tobacco products (AOR: 2.17), and consumption of processed food (AOR: 1.24). Only among girls, non-slum urban residence, Muslim religion, and household size ≤4 were also associated with depression.

**Conclusion** The prevalence of depression among adolescent boys and girls is high in Bangladesh. In most sociodemographic, lifestyle and anthropometric strata, the prevalence is higher among girls. In this age group, depression is associated with a number of sociodemographic and lifestyle factors. The government

## Strengths and limitations of this study

- To the best of our knowledge, this is the first paper reporting prevalence, sex-difference and associated factors of depression among the adolescent girls and boys using a nationally representative data set.
- Depression was measured through face-to-face interviews using the adolescent Patient Health Questionnaire.
- Data on sociodemographic and lifestyle factors were collected based on self-reports, which is prone to information bias.
- No data were collected on treatment-seeking practices of adolescents with depression.
- This cross-sectional study cannot establish causal association between depression and the factors examined.

of Bangladesh should consider these findings while integrating adolescent mental health in the existing and future programmes.

## INTRODUCTION

Adolescence is the period when a human being transforms from childhood to adulthood. The WHO defines adolescents as persons from 10 through 19 years of age.<sup>1</sup> As per the latest census carried out in Bangladesh, adolescents comprise more than one-fifth of the total population.<sup>2</sup> During adolescence, every human being experiences physical, psychological and social changes.<sup>1</sup> As these changes occur simultaneously and rapidly, adolescence is considered a period of vulnerability.<sup>1</sup> Therefore, an adolescent can suffer from physical and mental health disorders, including depression.

Worldwide, depression is a common mental health disorder, and more than 264 million people are affected by it. Depression is also a

major cause of disability and therefore, a major contributor to the global burden of disease.<sup>3</sup> Depression can also be common among adolescents.<sup>4</sup> In adolescents and young people, depression can increase the risk of poor health, suicide, unhealthy lifestyle behaviour<sup>5</sup> and poor social well-being.<sup>6</sup> There is also evidence that early life depression is related to lower educational attainment.<sup>7</sup>

Data from small studies revealed that there is a high prevalence of depression among adolescents in Bangladesh. For example, in a recent publication, Anjum *et al* reported that 36.6% of urban and semiurban adolescents in Bangladesh have depressive symptoms, and there is a higher prevalence of depression among the girls (42.9%) than the boys (25.7%).<sup>7</sup> Authors of another recently published study reported that 19% of male and 30% of female school-going adolescents in Dhaka city suffer from depressive symptoms.<sup>5</sup> However, as mentioned earlier, these studies were confined in small areas of Bangladesh and therefore, unable to report national estimates.

The government of Bangladesh developed a national strategy for adolescent health to prioritise activities to improve adolescent health during 2017–2030. One of the four strategic areas of this document is the mental health of adolescents. During the development of this strategy, the policymakers and programme managers in Bangladesh mentioned that there was a dearth of information on the prevalence of mental health problems among adolescents in Bangladesh. They also highlighted that lack of information posed a challenge for developing appropriate interventions to improve the mental health of adolescents.<sup>1</sup> The United Nations Population Fund estimated that the proportion of adolescents in Bangladesh would continue to increase.<sup>8</sup> Therefore, adolescents' health and adolescents' mental health are essential for attaining sustainable development goals in Bangladesh.

Given the lack of information about the mental health status of adolescents, we wanted to estimate the prevalence of depression among adolescent boys and girls in Bangladesh. We recently carried out a nationwide survey to understand the food security, nutrition and health status of six population groups (less than 5-year-old children, adolescent girls, adolescent boys, women aged 20–59 years, men aged 20–59 years and elderly persons). This survey was carried out as the 2018–2019 round of national nutrition surveillance. In this survey, we assessed depression along with nutritional status, non-communicable disease-related risk factors and dietary practices among the adolescents girls and boys. In this paper, we aimed to report the prevalence and associated factors of depression among adolescent girls and boys in Bangladesh.

## MATERIALS AND METHODS

### Study design and setting

This cross-sectional study was implemented between April 2018 and October 2019, and the data collection period was from 6 October 2018 to 31 October 2019. We enrolled participants from 82 randomly selected clusters

(57 rural, 15 non-slum urban and 10 slums) from all the divisions (Barisal, Chattogram, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur and Sylhet) and all types of residence (rural, non-slum urban and slums) of Bangladesh.

### Sampling

We employed separate sampling techniques to select study subjects from rural and non-slums urban areas and slums. For the selection of rural clusters, two districts were randomly selected from each division in the first stage of the four-stage sampling. Afterwards, one sub-district was randomly selected from each of the districts. In the third stage, we randomly selected 32 unions (two unions from each of the selected sub-district). Each selected union was divided into segments, with 250–400 households keeping the geographical demarcation of the villages uninterrupted. From the listed segments, we randomly picked two segments and these segments were our rural clusters. Accordingly, we selected 64 clusters from rural areas. However, due to administrative embargo and financial constraints, we could collect data from 57 rural clusters.

For the selection of the non-slum urban clusters, we randomly selected 16 wards (lowest administrative unit in the urban areas) from the eight administrative divisions. We then identified the *mahallas* in those wards. If the *mahalla* had >500 households, we divided the *mahalla* into two or more segments so that each segment had 250–400 households within a demarcated geographical boundary. We randomly picked one from the listed *mahalla*/segments as the non-slum urban cluster. We eventually found that one of these clusters overlapped with a slum cluster, but we did not arrange a replacement cluster. Therefore, we collected data from 15 urban clusters.

For the selection of slum clusters, we used data from the Census of Slum Areas and Floating Population 2014.<sup>9</sup> In the first stage, we identified slums with  $\geq 300$  households. If there were >500 households in any slums, we divided the slum into two segments within demarcated geographical boundaries. Then, we randomly selected 10 slums cluster, each with  $\geq 250$ –300 households. We randomly selected one cluster from each division, except for Dhaka and Chattogram. As there are more slum population in Dhaka and Chattogram division, we selected two slum clusters from each of them.

We determined the sample size to generate estimates at the national, divisional and slum level. In case of adolescents and other population groups included in the survey, we noticed that the prevalence ( $p$ ) of key variables were between 4% and 98%. Considering the probability of type I error,  $\alpha=0.05$ ; margin of error,  $d=0.05$  or  $p/2$  when  $p \leq 0.1$ ; design effect=1.61, we calculated that we needed 62 adolescent boys and 62 adolescent girls from each cluster. Therefore, the estimated sample size for adolescent girls and boys in the country was 11 160 (5580 in each group). In reality, from the 82 completed clusters, we could collect data from 9856 adolescents.

## Study procedures

In each cluster, we listed all eligible participants in the households. Afterwards, we randomly selected the required number of study participants from each cluster with the condition that more than one eligible participant from one population group should not be selected. We listed 25 371 households, 10 529 adolescent boys and 10 211 adolescent girls in the completed clusters and collected data from randomly selected 4907 adolescent boys and 4949 adolescent girls. Five data collection teams, each comprising one supervisor and four or five data collectors were deployed. The members of these teams were trained and standardised by the investigators and field coordinator of the study.

We collected data using face-to-face interviews and physical measurements after taking written informed consents. If the adolescents were less than 18 years old, informed written assents were taken, and informed written consent was taken from one of the parents or guardians. The data collectors entered data in tablet computers (Samsung Galaxy Tab A7) using a customised SurveyCTO application. They uploaded the data to the SurveyCTO server at the end of data collection everyday. Data collection questionnaires were pretested, and modifications were made. To ensure data quality, the data collection supervisors reinterviewed 5% of the study participants selected randomly within 48 hours of the initial visit by the data collectors. The data collection supervisors also observed the interviews of another 5% of the randomly selected participants.

## Outcome measures

We used the nine-item adolescent Patient Health Questionnaire (PHQ-9) to measure the level of depression among both adolescent girls and boys. PHQ-9 has 89.5% sensitivity and 78.8% specificity for detecting depression among adolescents. Moreover, PHQ-9 has similar sensitivity and specificity when compared with other tools used in the primary healthcare settings, for example, Beck Depression Inventory and Short Mood and Feelings Questionnaires. PHQ-9 also has high reliability (Cronbach's  $\alpha=0.83$ ) when used in Bangladeshi adolescents.<sup>7</sup>

In the PHQ-9 questionnaire, study participants were asked how often they were bothered by nine specific symptoms related to depression over the last 2 weeks. Each symptom has four response options: not at all (score=0), several days (score=1), more than half of the days (score=2) and nearly every day (score=3). The scores of the individual study participants for all nine symptoms are added and then categorised into five levels of depression: none or minimal depression (score 0–4), mild depression (score 5–9), moderate depression (score 10–14), moderately severe depression (score 15–19) and severe depression (score 20–27).<sup>7</sup> When the PHQ-9 score was between 5–27, the study participant was categorized as having 'any depression'.

## Other measures

The household listing questionnaire included the numbers of children aged 0–5 years, children aged 6–9 years, adolescents aged 10–19 years, women aged 20–59 years, men aged 20–59 years and persons aged  $\geq 60$  years along with other variables. The household questionnaire included questions on age, education, occupation of the household head, land ownership, livestock and asset ownership, household income, water, sanitation and hygiene practices, food security, and household use of salt, fuel and cooking oil. For measuring household food security, we used the Household Food Insecurity Access Scale questionnaire developed by the Food and Nutrition Technical Agency (FANTA). For collecting other household data, we used standard questions used by Measure Demographic and Health Surveys (Measure DHS) for Demographic Health Surveys. Measure DHS questions were also used to collect data on age, education, maternal and paternal education, maternal and paternal occupation, marital status from both adolescent girls and boys. From the adolescent girls, we collected additional data on reproductive history and menstrual hygiene. Women's Dietary Diversity Questionnaire was used to collect data on dietary practices of both adolescent girls and boys.<sup>10</sup> We used WHO STEPS survey questions to collect data on lifestyle behaviour (use of tobacco products, physical activity and fruits and vegetable intake).<sup>11</sup> Use of any tobacco product comprises consumption of smoked and/or smokeless tobacco products, insufficient physical activity was defined as having  $<150$  minutes of moderate-intensity physical activity or  $<75$  minutes of vigorous intensity physical activity or equivalent during a typical week, and sufficient fruits and vegetables intake was defined as consumption of five or more servings of fruits and vegetables on an average day.

Concerning physical measurements, we measured the height of the adolescents using locally made stadiometers and weight using a weighing scale (Tanita UM070). All physical measurements were taken based on WHO guidelines, as specified in the Food and Nutrition Technical Assistance anthropometry manual.<sup>12</sup> We took at least two measurements for each anthropometric indicator, and if the difference between two measurements was more than a prespecified limit (0.1 kg for weight and 0.5 cm for height), we took a third measurement. We calculated Body Mass Index (BMI) using the WHO-recommended methods and categorised adolescents as underweight ( $BMI < 18.5 \text{ kg/m}^2$ ), normal ( $BMI: 18.5\text{--}22.9 \text{ kg/m}^2$ ) and overweight or obese ( $BMI \geq 23.0 \text{ kg/m}^2$ ) using Asian cut-off for BMI.<sup>13</sup>

## Statistical analysis

We used Stata V.15.0 (Stata Corp, College Station, TX, USA) to clean and analyse the data. We carried out descriptive analyses to report the background characteristics of the respondents. We constructed sampling weights, considering the selection probability of each participant in the final sample and used these weights to estimate

the prevalence of different levels of depression for both adolescent boys and girls. We carried out analyses to test whether the prevalence of any depression significantly differs between the boys and girls across different sociodemographic, life-style and anthropometric strata. We performed bivariate logistic regression to explore the association between any depression and each of the explanatory variables identified based on literature review and available data. Finally, we carried out multivariable logistic regression taking the explanatory variables that had a p value ( $\leq 0.2$ ) in the bivariate analysis. If any of the explanatory variable is highly correlated (correlation coefficient of  $\geq 0.5$ ) with another explanatory variable, we selected the variable that had the lowest p value in the bivariate analysis. We also carried out regression diagnostics to verify whether the underlying assumptions of logistic regression were met.

### Ethics

The data collectors administered informed written consent and assent (for 10–17-year-old adolescents) process as required. As part of the consenting process, each participant received information on the study, rights of the respondents, confidentiality and privacy procedures and her/his possible activities as a study participant. Each household received a small gift after completion of the data collection.

### RESULTS

In this study, we analysed data from 9856 adolescents, and of them, 4907 (49.8%) were boys, and 4949 (50.2%) were girls. Fifty seven percent of boys and fifty four percent of girls were in their early adolescence, and about one-third of the adolescents were from urban areas (non-slum urban and slums). A higher proportion of adolescent girls than the boys (62% vs 52%) had some secondary education. Concerning the occupation of the mothers of the adolescents, more than 86% were homemakers; whereas, the occupations of the fathers of the adolescents had more variations. Eighty-seven per cent of the adolescents were Muslims; 49% lived in households that had at least another adolescent family member; about 12% of the adolescents lived in households with severe food insecurity (table 1).

We also found that about 5% and 1% of adolescent boys and girls, respectively, were current user of any tobacco products, 52% of boys and 55% of girls consumed inadequately diverse diet; 91% of boys and 94% of girls consumed less than five servings of fruits and vegetable per day; 81% of boys and 73% of girls consumed processed food in the last 24 hours; 33% of boys and 51% of girls did not perform at least 150 minutes of moderate-intensity physical activity or 75 minutes of vigorous physical activity or equivalent in a typical week; and 9% of boys and 10% of girls spent more than 2 hours/day for watching television (table 1). The height of 80% of girls and 38% of boys were between 140 and 160 cm. The majority of the

adolescents were underweight (64% of boys and 52% of girls); 8% of boys and 12% of girls were overweight or obese. (table 1).

As shown in figure 1, the overall prevalence of depression was 24.5%, and the prevalence of depression was higher among girls (27.0%) than the boys (22.0%). Among the depressed boys and girls, nearly three-fourths (73%) were suffering from mild depression. The prevalence of moderate depression among girls and boys was 5.0% and 5.9%, respectively. The prevalence of moderately severe and severe depression combined was 1% for boys and 1.4% for girls.

We further compared the prevalence of any depression (mild+moderate+moderately severe+severe) between boys and girls across different sociodemographic, life-style and anthropometric strata. In most cases, there was a statistically significant difference between the prevalence of any depression among girls and boys. In case of girls, the highest prevalence of depression was noticed among the consumers of tobacco products (49.0%), and in case of boys, the highest prevalence of depression was noticed among the smokers (46.0%). Adolescents living in severely food insecure households also had a high prevalence of depression (43.0% among girls and 33.3% among the boys) (table 2).

Multivariable logistic regression revealed that higher age, higher maternal education, higher paternal education, paternal occupation, absence of a 6–9-year-old member in the household, absence of another adolescent household member, food insecurity, household use of solid-biomass fuel, and tobacco consumption, household consumption of unfortified oil, household consumption of non-iodised salt, processed food intake, insufficient physical activity and higher television viewing time per day were associated with depression in adolescent boys. Compared with mothers and fathers with no education, adolescent boys having mothers and fathers with completed secondary or higher education had higher odds of depression (mothers: adjusted odds ratio (AOR): 1.57, 95% CI: 1.13 to 2.19; fathers: AOR: 1.42, 95% CI: 1.06 to 1.89). We also found that compared with adolescent boys living in food-secured households, adolescent boys living in the severe food-insecure households had higher odds of depression (AOR: 1.44, 95% CI: 1.17 to 1.79). We also noticed a protective effect of mild food insecurity on depression (AOR: 0.63, 95% CI: 0.52 to 0.76) among adolescent boys keeping the same reference group. Adolescent boys with insufficient physical activity (AOR: 1.24, 95% CI: 1.06 to 1.46) and  $\geq 121$  min/day television viewing time (AOR: 1.95, 95% CI: 1.51 to 2.51) had higher odds of depression compared with their counterparts performing sufficient physical activity and with  $\leq 60$  min/day television viewing time, respectively (table 3).

In case of adolescent girls, multivariable logistic regression revealed that age, non-slum urban residence, partial primary maternal education, paternal occupation, being Muslim, household size  $\leq 4$ , absence of a

**Table 1** Background characteristics of the study population by sex

	Whole sample (n=9856)		Adolescent boy (n=4907)		Adolescent girl (n=4949)	
	n	%	n	%	n	%
<b>Sociodemographic characteristics</b>						
<b>Age</b>						
10–14	5462	55.4	2789	56.8	2673	54
15–17	3062	31.1	1524	31.1	1538	31.1
18–19	1332	13.5	594	12.1	738	14.9
<b>Place of residence</b>						
Rural	6887	69.9	3438	70.1	3449	69.7
Non-slum urban	1763	17.9	873	17.8	890	18
Slum	1206	12.2	596	12.2	610	12.3
<b>Educational status</b>						
No education	221	2.24	161	3.28	60	1.21
Partial primary	2604	26.4	1518	30.9	1086	21.9
Complete primary	1395	14.2	658	13.4	737	14.9
Partial secondary	4357	44.2	1973	40.2	2384	48.2
Complete secondary or above	1279	13	597	12.2	682	13.8
<b>Maternal education</b>						
No education	3714	37.7	1835	37.4	1879	38
Partial primary	1270	12.9	633	12.9	637	12.9
Complete primary	1721	17.5	844	17.2	877	17.7
Partial secondary	2130	21.6	1081	22	1049	21.2
Complete secondary or above	1021	10.4	514	10.5	507	10.2
<b>Paternal education</b>						
No education	4140	42	2026	41.3	2114	42.7
Partial primary	1049	10.6	532	10.8	517	10.5
Complete primary	1467	14.9	713	14.5	754	15.2
Partial secondary	1699	17.2	875	17.8	824	16.7
Complete secondary or above	1501	15.2	761	15.5	740	15
<b>Maternal occupation</b>						
Housewife	8499	86.2	4249	86.6	4250	85.9
Other	1357	13.8	658	13.4	699	14.1
<b>Paternal occupation</b>						
Farmer	1556	15.8	777	15.8	779	15.8
Day labourer	2418	24.6	1188	24.2	1230	24.9
Salaried staff	1454	14.8	744	15.2	710	14.4
Business	2268	23	1149	23.4	1119	22.6
Others	2155	21.9	1049	21.4	1106	22.4
<b>Marital status</b>						
Currently married	725	7.36	43	0.88	682	13.8
Others	9131	92.6	4864	99.1	4267	86.2
<b>Religion</b>						
Muslim	8611	87.4	4272	87.1	4339	87.7
Other	1245	12.6	635	12.9	610	12.3
<b>Household size</b>						
≤4	5352	54.3	2725	55.5	2627	53.1
≥5	4504	45.7	2182	44.5	2322	46.9
<b>Less than 5-year-old household member</b>						

Continued

Table 1 Continued

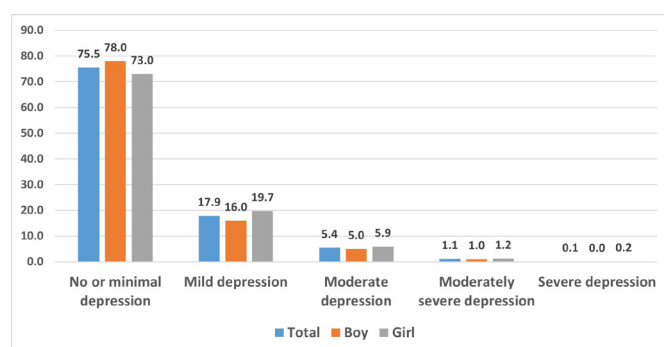
	Whole sample (n=9856)		Adolescent boy (n=4907)		Adolescent girl (n=4949)	
Yes	2688	27.3	1173	23.9	1515	30.6
No	7168	72.7	3734	76.1	3434	69.4
6–9-year-old household member						
Yes	3043	31.8	1475	31	1568	32.6
No	6526	68.2	3286	69	3240	67.4
Another adolescent household member						
Yes	4789	48.6	2399	48.9	2390	48.3
No	5067	51.4	2508	51.1	2559	51.7
≥60-year-old household member						
Yes	2738	27.8	1360	27.7	1378	27.8
No	7118	72.2	3547	72.3	3571	72.2
Food security status of household						
Food secure	5680	57.7	2817	57.4	2863	57.9
Mild food insecurity	2477	25.1	1244	25.4	1233	24.9
Moderate food insecurity	498	5.06	248	5.06	250	5.05
Severe food insecurity	1196	12.1	595	12.1	601	12.2
Household use of fuel						
Clean	2155	21.9	1074	21.9	1081	21.9
Unclean	7696	78.1	3830	78.1	3866	78.2
Household wealth						
Richest	1961	19.9	975	19.9	986	19.9
Richer	1972	20	983	20	989	20
Middle	1970	20	981	20	989	20
Poorer	1969	20	981	20	988	20
Poorest	1979	20.1	984	20.1	995	20.1
<b>Lifestyle characteristics</b>						
Smoking						
Currently smoke	194	1.97	191	3.89	3	0.06
Currently do not smoke	9662	98	4716	96.1	4946	99.9
Any tobacco use						
Yes	291	2.95	245	4.99	46	0.93
No	9565	97.1	4662	95	4903	99.1
Dietary diversity						
Inadequate (<5 food groups per day)	5293	53.7	2553	52	2740	55.4
Adequate (≥5 food groups per day)	4563	46.3	2354	48	2209	44.6
Fruits and vegetable intake						
Insufficient (<5 servings per day)	9080	92.1	4451	90.7	4629	93.5
Sufficient (≥5 servings per day)	776	7.87	456	9.29	320	6.47
Processed food intake						
Yes	7576	76.9	3982	81.2	3594	72.6
No	2280	23.1	925	18.9	1355	27.4
Consumption of fortified oil						
Yes	3013	30.6	1484	30.2	1529	30.9
No	6843	69.4	3423	69.8	3420	69.1
Consumption of iodised salt						
Yes	7115	72.2	3526	71.9	3589	72.6
No	2736	27.8	1378	28.1	1358	27.5

Continued

Table 1 Continued

	Whole sample (n=9856)		Adolescent boy (n=4907)		Adolescent girl (n=4949)	
<b>Physical activity</b>						
Insufficient (<150 minutes of moderate or <75 minutes of vigorous physical activity or equivalent/week)	4128	41.9	1613	32.9	2515	50.8
Sufficient (≥150 minutes of moderate or ≥75 minutes of vigorous physical activity or equivalent/week)	5728	58.1	3294	67.1	2434	49.2
<b>Sedentary time/day</b>						
≤6 hours	4122	41.8	2141	43.6	1981	40
>6 hours	5734	58.2	2766	56.4	2968	60
<b>Television viewing time/day</b>						
None	3520	35.7	1678	34.2	1842	37.2
≤60 minutes	3519	35.7	1915	39	1604	32.4
61–120 minutes	1883	19.1	896	18.3	987	19.9
≥121 minutes	934	9.48	418	8.52	516	10.4
<b>Anthropometric characteristics</b>						
<b>Height</b>						
<140 cm	1780	18.1	1021	20.8	759	15.4
≥140–<160 cm	5814	59.1	1861	38	3953	80.1
≥160 cm	2243	22.8	2018	41.2	225	4.56
<b>Weight</b>						
<30 kg	1602	16.3	949	19.4	653	13.2
≤30–<50 kg	5809	59	2446	49.9	3363	68
≥50 kg	2433	24.7	1505	30.7	928	18.8
<b>Body Mass Index</b>						
Underweight	5689	57.9	3110	63.5	2579	52.3
Normal	3180	32.3	1405	28.7	1775	36
Overweight and obese	965	9.81	383	7.82	582	11.8

6–9-year-old member in the household, food insecurity, household consumption of unfortified oil, household consumption of non-iodised salt, insufficient physical activity and higher television viewing time were associated with depression. Compared with adolescent girls in the 10–14 years age group, adolescent girls between 14 and 17 years (AOR: 1.45, 95% CI: 1.20 to 1.74) and 18–19 years (AOR: 1.92, 95% CI: 1.51 to 2.45) of age



**Figure 1** Prevalence of levels of depression among adolescent boys and girls.

had higher odds of depression. Adolescent girls living in non-slum urban areas had higher odds of depression (AOR: 1.56, 95% CI: 1.27 to 1.92) compared with adolescent girls living in rural areas. Compared with adolescent girls living in food secure households, adolescent girls living in severe food insecure households had higher odds of depression (AOR: 1.64, 95% CI: 1.33 to 2.02). Like the adolescent boys, we noticed a protective effect of mild food insecurity on depression (AOR: 0.77, 95% CI: 0.64 to 0.92) among adolescent girls keeping the same reference group. Household consumption of unfortified oil (AOR: 1.61, 95% CI: 1.36 to 1.90) and household consumption of non-iodised salt (AOR: 1.81, 95% CI: 1.54 to 2.12) were associated with the higher odds of depression. Moreover, adolescent girls with insufficient physical activity (AOR: 1.44, 95% CI: 1.25 to 1.67) and ≥121 min/day television viewing time (AOR: 1.99, 95% CI: 1.59 to 2.49) had higher odds of depression compared with adolescent girls with performing sufficient physical activity and with <60 min/day television viewing time, respectively (table 3).



**Table 2** Prevalence of any depression\* among adolescent boys and girls by sociodemographic, lifestyle and anthropometric variables

	Whole sample (n=9569) % (95% CI)	Adolescent boy (n=4761) % (95% CI)	Adolescent girl (n=4808) % (95% CI)	P value
Overall	24.52 (18.11 to 32.30)	22.02 (16.00 to 29.50)	27.01 (20.07 to 35.29)	<0.001
<b>Sociodemographic variables</b>				
<b>Age</b>				
10–14	22.89 (16.31 to 31.14)	20.82 (14.51 to 28.94)	25.02 (18.00 to 33.64)	0.001
15–17	25.24 (18.95 to 32.77)	23.05 (16.95 to 30.55)	27.39 (20.33 to 35.81)	0.068
18–19	30.44 (23.71 to 38.13)	25.41 (19.12 to 32.93)	34.82 (26.35 to 44.37)	0.015
<b>Place of residence</b>				
Rural	24.71 (18.04 to 32.86)	22.28 (16.02 to 30.10)	27.14 (19.90 to 35.83)	<0.001
Non-slum urban	20.51 (11.83 to 33.15)	15.19 (9.11 to 24.23)	25.30 (14.48 to 40.39)	<0.001
Slum	14.78 (4.29 to 40.16)	15.45 (3.83 to 45.61)	14.15 (4.72 to 35.44)	0.66
<b>Educational status</b>				
No education	20.87 (12.73 to 32.28)	18.80 (10.81 to 30.65)	30.90 (13.63 to 55.89)	0.239
Partial primary	23.10 (16.16 to 31.89)	21.09 (14.32 to 29.93)	25.81 (18.07 to 35.42)	0.052
Complete primary	22.74 (16.63 to 30.28)	20.52 (14.23 to 28.66)	24.92 (18.17 to 33.17)	0.123
Partial secondary	24.50 (18.09 to 32.28)	22.61 (16.37 to 30.37)	26.02 (19.09 to 34.39)	0.089
Complete secondary or above	30.74 (22.19 to 40.86)	25.12 (17.40 to 34.82)	36.07 (26.21 to 47.27)	0.002
<b>Maternal education</b>				
No education	25.22 (18.13 to 33.95)	21.85 (15.57 to 29.76)	28.66 (20.51 to 38.47)	<0.001
Partial primary	25.63 (18.32 to 34.63)	24.70 (16.37 to 35.47)	26.62 (18.71 to 36.39)	0.661
Complete primary	23.96 (18.38 to 30.59)	22.36 (16.39 to 29.73)	25.46 (19.11 to 33.06)	0.321
Partial secondary	22.15 (15.84 to 30.09)	20.89 (14.08 to 29.85)	23.38 (16.96 to 31.32)	0.313
Complete secondary or above	27.35 (17.64 to 39.83)	20.36 (11.41 to 33.68)	33.83 (22.71 to 47.08)	0.008
<b>Paternal education</b>				
No education	26.45 (19.09 to 35.41)	23.59 (16.27 to 32.92)	29.19 (21.53 to 38.25)	0.006
Partial primary	22.46 (15.95 to 30.64)	21.32 (14.94 to 29.48)	23.69 (15.68 to 34.13)	0.532
Complete primary	20.84 (15.69 to 27.15)	17.82 (12.70 to 24.42)	23.95 (17.13 to 32.43)	0.099
Partial secondary	22.53 (16.13 to 30.54)	21.95 (15.70 to 29.82)	23.14 (16.02 to 32.21)	0.613
Complete secondary or above	26.66 (17.57 to 38.27)	22.35 (13.46 to 34.76)	30.64 (20.53 to 43.02)	0.053
<b>Maternal occupation</b>				
Homemakers	24.11 (17.70 to 31.94)	21.47 (15.62 to 28.76)	26.74 (19.61 to 35.32)	<0.001
Other	27.89 (20.46 to 36.78)	26.56 (16.98 to 39.01)	29.16 (21.30 to 38.51)	0.649
<b>Paternal occupation</b>				
Farmer	18.48 (13.93 to 24.10)	14.66 (10.94 to 19.37)	22.13 (15.78 to 30.13)	0.011
Day labourer	26.91 (18.98 to 36.65)	26.22 (18.00 to 36.53)	27.58 (19.61 to 37.28)	0.509
Salaried staff	21.53 (13.86 to 31.87)	16.97 (10.06 to 27.20)	25.81 (17.04 to 37.07)	0.006
Business	25.97 (18.86 to 34.61)	23.26 (16.33 to 32.00)	28.75 (20.38 to 38.88)	0.092
Others	26.26 (19.06 to 34.99)	23.63 (16.67 to 32.36)	28.98 (20.76 to 38.85)	0.082
<b>Religion</b>				
Muslim	25.06 (18.37 to 33.20)	22.47 (16.17 to 30.32)	27.61 (20.36 to 36.27)	<0.001
Other	20.43 (12.35 to 31.89)	18.73 (10.35 to 31.52)	22.25 (13.88 to 33.69)	0.273
<b>Household size</b>				
≤4	28.35 (20.65 to 37.56)	26.09 (18.57 to 35.33)	30.83 (22.84 to 40.16)	<0.001
≥5	20.72 (15.48 to 27.15)	17.54 (13.01 to 23.23)	23.57 (17.21 to 31.40)	0.005
<b>Less than 5-year-old household member</b>				
Yes	23.48 (17.53 to 30.71)	20.54 (15.04 to 27.40)	25.65 (18.99 to 33.67)	0.013
No	24.89 (18.23 to 33.01)	22.44 (16.20 to 30.23)	27.61 (20.25 to 36.42)	0.001
<b>6–10-year-old household member</b>				
Yes	22.71 (16.32 to 30.69)	20.49 (14.37 to 28.35)	24.7 (17.30 to 33.97)	<0.001

Continued

Table 2 Continued

	Whole sample (n=9569) % (95% CI)	Adolescent boy (n=4761) % (95% CI)	Adolescent girl (n=4808) % (95% CI)	P value
No	25.35 (18.74 to 33.34)	22.67 (16.41 to 30.43)	28.16 (21.07 to 36.53)	<0.001
Another adolescent household member				
Yes	22.25 (16.48 to 29.34)	19 (13.77 to 25.63)	25.52 (18.87 to 33.53)	<0.001
No	27.58 (19.98 to 36.75)	26.14 (18.64 to 35.34)	29 (21.12 to 38.39)	0.036
≥60-year-old household member				
Yes	23.41 (16.71 to 31.76)	21.77 (15.30 to 30.01)	24.98 (17.49 to 34.34)	0.198
No	24.99 (18.51 to 32.84)	22.12 (16.07 to 29.64)	27.88 (20.77 to 36.32)	<0.001
Food security status of household				
Food secure	24.85 (17.20 to 34.49)	23.17 (15.87 to 32.53)	26.47 (18.34 to 36.59)	0.009
Mild food insecurity	17.23 (14.23 to 20.72)	14.4 (11.25 to 18.25)	20.07 (14.69 to 26.80)	0.117
Moderate food insecurity	23.89 (17.83 to 31.22)	18.12 (12.71 to 25.18)	29.74 (21.05 to 40.19)	0.012
Severe food insecurity	37.93 (25.95 to 51.60)	33.25 (21.83 to 47.05)	43.00 (29.76 to 57.32)	0.015
Household use of fuel				
Clean	18.83 (11.22 to 29.87)	11.96 (6.61 to 20.67)	25.44 (15.64 to 38.56)	<0.001
Unclean	24.95 (18.37 to 32.94)	22.76 (16.53 to 30.47)	27.13 (20.02 to 35.65)	0.001
Household wealth				
Richest	26.89 (17.22 to 39.40)	22.74 (14.54 to 33.74)	31.04 (19.66 to 45.29)	0.002
Richer	25.62 (19.15 to 33.38)	21.07 (14.89 to 28.94)	30.13 (22.42 to 39.16)	0.004
Middle	24.63 (18.06 to 32.64)	23.42 (16.89 to 31.52)	25.75 (18.57 to 34.52)	0.306
Poorer	22.66 (16.56 to 30.19)	21.49 (15.06 to 29.71)	23.8 (17.29 to 31.82)	0.389
Poorest	24.18 (16.80 to 33.50)	21.73 (15.47 to 29.63)	26.83 (17.70 to 38.49)	0.078
<b>Lifestyle variables</b>				
Smoking				
Currently smoke	45.94 (34.61 to 57.70)	45.95 (34.61 to 57.73)	31.91 (9.45 to 67.80)	0.446
Currently do not smoke	24.15 (17.84 to 31.84)	21.17 (15.40 to 28.39)	27.01 (20.07 to 35.29)	<0.001
Any tobacco use				
Yes	44.81 (33.69 to 56.47)	44.42 (33.37 to 56.04)	49.00 (22.14 to 76.45)	0.753
No	24.00 (17.74 to 31.62)	20.94 (15.27 to 28.03)	26.91 (20.00 to 35.16)	<0.001
Dietary diversity				
Inadequate (<5 food groups per day)	23.33 (17.11 to 30.97)	20.02 (14.38 to 27.19)	26.34 (19.49 to 34.56)	<0.001
Adequate (≥5 food groups per day)	25.86 (18.64 to 34.69)	24.06 (16.87 to 33.10)	27.85 (20.17 to 37.09)	0.074
Fruits and vegetables intake				
Insufficient (<5 servings per day)	24.51 (17.98 to 32.48)	21.91 (15.74 to 29.63)	27.01 (19.98 to 35.42)	<0.001
Sufficient (≥5 servings per day)	24.60 (17.66 to 33.19)	23.09 (14.98 to 33.85)	27.03 (18.66 to 37.43)	0.482
Processed food intake				
Yes	23.74 (17.22 to 31.78)	22.05 (16.01 to 29.57)	25.66 (18.45 to 34.49)	0.003
No	26.84 (19.43 to 35.82)	21.88 (14.49 to 31.64)	30.17 (22.11 to 39.67)	0.011
Consumption of fortified oil				
Yes	18.72 (12.54 to 27.00)	16.2 (10.10 to 24.96)	21.02 (14.03 to 30.25)	0.122
No	26.21 (19.46 to 34.30)	23.62 (17.21 to 31.49)	28.85 (21.55 to 37.45)	0.001
Consumption of iodised salt				
Yes	18.96 (14.16 to 24.91)	16.66 (12.36 to 22.08)	21.21 (15.57 to 28.22)	0.007
No	34.76 (25.15 to 45.79)	31.7 (22.50 to 42.60)	37.86 (27.50 to 49.46)	0.012
Physical activity				
Insufficient (<150 minutes of moderate or <75 minutes of vigorous physical activity or equivalent/week)	26.95 (19.97 to 35.28)	20.2 (14.85 to 26.88)	30.84 (22.79 to 40.25)	<0.001
Sufficient (≥150 minutes of moderate or ≥75 minutes of vigorous physical activity or equivalent/week)	22.94 (16.53 to 30.90)	22.76 (16.14 to 31.08)	23.19 (16.67 to 31.30)	0.816

Continued

Table 2 Continued

	Whole sample (n=9569) % (95% CI)	Adolescent boy (n=4761) % (95% CI)	Adolescent girl (n=4808) % (95% CI)	P value
<b>Sedentary time/day</b>				
≤6 hours	25.38 (18.04 to 34.46)	23.07 (15.93 to 32.17)	28.11 (20.14 to 37.74)	0.017
>6 hours	23.93 (17.90 to 31.22)	21.19 (15.51 to 28.26)	26.36 (19.64 to 34.39)	0.007
<b>Television viewing time/day</b>				
None	20.71 (15.76 to 26.72)	18.11 (13.04 to 24.58)	23.18 (17.68 to 29.76)	0.03
≤60 minutes	23.44 (17.14 to 31.20)	23.08 (16.80 to 30.83)	23.86 (17.04 to 32.35)	0.702
61–120 minutes	25.81 (17.54 to 36.26)	21.07 (14.05 to 30.36)	30.1 (20.09 to 42.45)	0.005
≥121 minutes	40.53 (28.53 to 53.78)	34.65 (21.14 to 51.20)	45 (33.20 to 57.40)	0.066
<b>Anthropometric variables</b>				
<b>Height</b>				
<140 cm	19.72 (13.60 to 27.72)	18.85 (13.10 to 26.35)	20.85 (13.62 to 30.57)	0.428
≥140–<160 cm	26.61 (19.49 to 35.20)	23.23 (15.84 to 32.72)	28.24 (20.93 to 36.90)	0.034
≥160 cm	23.05 (17.19 to 30.18)	22.61 (16.72 to 29.84)	27.51 (19.34 to 37.52)	0.186
<b>Weight</b>				
<30 kg	21.89 (15.01 to 30.78)	19.89 (13.90 to 27.62)	24.61 (16.07 to 35.76)	0.057
≤30–<50 kg	25.52 (18.98 to 33.38)	24.38 (17.79 to 32.46)	26.34 (19.56 to 34.48)	0.258
≥50 kg	24.03 (16.80 to 33.12)	19.4 (13.17 to 27.63)	32.51 (23.39 to 43.19)	<0.001
<b>Body Mass Index</b>				
Underweight	24.41 (17.86 to 32.42)	22.94 (16.68 to 30.69)	26.14 (18.98 to 34.85)	0.037
Normal	23.89 (17.81 to 31.25)	20.28 (14.35 to 27.87)	26.78 (20.18 to 34.60)	0.003
Overweight and obese	28.17 (19.10 to 39.45)	20.54 (11.23 to 34.55)	32.86 (23.38 to 43.98)	0.022

P value was significant at <0.05.

\*The cut-off of PHQ-9 score ≥5 was categorised as any depression for this analysis.

## DISCUSSION

To the best of our knowledge, our study is the first in Bangladesh reporting the prevalence of and factors associated with depression using a nationally representative sample of both adolescent boys and girls. In our study, we found a high prevalence of depression in both boys and girls but compared with boys, adolescent girls had a higher level of depression across many sociodemographic, lifestyle and anthropometric strata. Our analysis revealed that depression was associated with higher age, higher maternal education, paternal occupation e.g., business, absence of a 6–9-year-old member in the household, food insecurity, household consumption of unfortified oil, household use of non-iodised salt, insufficient physical activity and high television viewing time among both boys and girls. Only among boys, depression was also associated with higher paternal education, absence of another adolescent member in the household, household use of solid biomass fuel, use of any tobacco products and consumption of processed foods. Only among girls, non-slum urban residence, Muslim religion and household size ≤4 were also associated with depression.

Our findings about the prevalence of depression are consistent with a recently published study among adolescents in secondary schools. Though the study used Center for Epidemiological Studies Depression Scale (CESD-10), the authors of the study reported 25% overall prevalence of depression among the adolescents and a higher

prevalence of depression among female adolescents (30% in girls and 19% in boys).<sup>5</sup> Another study using the PHQ-9 questionnaire among 13–17-year-old adolescents living in urban and semiurban Bangladesh revealed a higher prevalence of depression (36.6%). However, as reported in our study, the authors of this study also reported a higher prevalence of depression among the girls (42.9%) than the boys (25.7%).<sup>7</sup> The difference in reported prevalence between these two studies can be due to the inclusion of 10–19-year-old adolescents and also adolescents from rural, non-slum urban and slum areas in our study.

As revealed in our study, the association of depression with female gender and age is not an uncommon finding. Adolescent girls have more challenges during the transition from childhood to adulthood due to physical (e.g., development of secondary sex characteristics), psychological (e.g., socioemotional) and physiological (e.g., hormonal) changes.<sup>14</sup> Moreover, cultural practices and gender norms in South-Asian societies may make girls more vulnerable to depression.<sup>15</sup> For example, in South-Asian societies, adolescents cannot discuss their pubertal changes with their parents, and this may have an impact on their physical and emotional health<sup>5</sup> leading to depression. Our findings concerning the higher prevalence of depression among adolescents in the higher age group are also consistent with results reported by other authors.<sup>5 16</sup> There is a possibility that

**Table 3** Multivariable association of sociodemographic, lifestyle and anthropometric variables with any depression\* among adolescent boys and girls

Variables	Adolescent boys (n=4761)				Adolescent girls (n=4808)			
	Crude odds ratio (COR) (95% CI)	P value	Adjusted odds ratio (COR) (95% CI)	P value	Crude odds ratio (COR) (95% CI)	P value	Adjusted odds ratio (COR) (95% CI)	P value
<b>Sociodemographic variables</b>								
Age								
10–14	Ref				Ref			
15–17	1.18 (1.02 to 1.38)	0.028	1.35 (1.12 to 1.63)	0.002	1.49 (1.29 to 1.72)	<0.001	1.45 (1.20 to 1.74)	<0.001
18–19	1.25 (1.02 to 1.55)	0.035	1.44 (1.11 to 1.86)	0.006	1.89 (1.58 to 2.26)	<0.001	1.92 (1.51 to 2.45)	<0.001
Place of residence								
Rural	Ref				Ref			
Non-slum urban	1.10 (0.92 to 1.32)	0.275	NA	NA	1.69 (1.44 to 1.99)	<0.001	1.56 (1.27 to 1.92)	<0.001
Slum	0.89 (0.72 to 1.11)	0.305	NA	NA	1.03 (0.84 to 1.26)	0.793	0.94 (0.75 to 1.18)	0.576
Educational status								
No education	Ref				Ref			
Partial primary	0.96 (0.65 to 1.43)	0.846	NA	NA	0.79 (0.44 to 1.42)	0.43	0.97 (0.52 to 1.82)	0.922
Complete primary	0.96 (0.63 to 1.45)	0.831	NA	NA	0.7 (0.38 to 1.27)	0.238	0.83 (0.44 to 1.58)	0.577
Partial secondary	0.95 (0.64 to 1.40)	0.797	NA	NA	0.92 (0.52 to 1.65)	0.786	0.97 (0.53 to 1.80)	0.931
Complete secondary or above	1.15 (0.76 to 1.76)	0.5	NA	NA	1.53 (0.85 to 2.77)	0.159	1.19 (0.63 to 2.26)	0.594
Maternal education								
No education	Ref				Ref			
Partial primary	1.37 (1.10 to 1.69)	0.004	1.34 (1.06 to 1.69)	0.015	1.35 (1.1 to 1.65)	0.004	1.42 (1.14 to 1.76)	0.002
Complete primary	1.14 (0.93 to 1.40)	0.196	1.26 (1.01 to 1.57)	0.045	0.96 (0.8 to 1.17)	0.704	1.05 (0.85 to 1.29)	0.666
Partial secondary	1.28 (1.07 to 1.54)	0.008	1.34 (1.08 to 1.67)	0.009	1.11 (0.93 to 1.32)	0.233	1.23 (0.99 to 1.52)	0.06
Complete secondary or above	1.16 (0.91 to 1.48)	0.225	1.57 (1.13 to 2.19)	0.007	1.37 (1.11 to 1.71)	0.004	1.35 (0.99 to 1.84)	0.062
Paternal education								
No education	Ref				Ref			
Partial primary	1.04 (0.82 to 1.32)	0.734	1.07 (0.83 to 1.38)	0.598	0.88 (0.7 to 1.1)	0.252	0.84 (0.66 to 1.07)	0.161
Complete primary	1.05 (0.85 to 1.29)	0.652	1.13 (0.9 to 1.43)	0.282	0.88 (0.72 to 1.07)	0.196	0.9 (0.73 to 1.12)	0.35
Partial secondary	1.19 (0.98 to 1.44)	0.077	1.37 (1.09 to 1.71)	0.006	0.91 (0.75 to 1.1)	0.315	0.91 (0.73 to 1.13)	0.384
Complete secondary or above	1.12 (0.92 to 1.37)	0.259	1.42 (1.06 to 1.89)	0.019	1.27 (1.06 to 1.53)	0.011	1.15 (0.88 to 1.51)	0.319
Maternal occupation								
Housewife	Ref				Ref			
Other	0.96 (0.79 to 1.18)	0.698	NA	NA	0.99 (0.82 to 1.19)	0.884	NA	NA
Paternal occupation								
Salaried staff	Ref				Ref			
Farmer	0.82 (0.63 to 1.07)	0.142	1.46 (1.14 to 1.88)	0.003	0.89 (0.7 to 1.13)	0.351	1.04 (0.79 to 1.37)	0.773
Day labourer	1.25 (0.99 to 1.57)	0.058	1.3 (0.97 to 1.75)	0.084	0.97 (0.78 to 1.21)	0.804	1.11 (0.86 to 1.42)	0.438
Business	1.29 (1.03 to 1.62)	0.029	1.7 (1.32 to 2.19)	<0.001	1.23 (0.99 to 1.52)	0.059	1.29 (1.03 to 1.63)	0.029
Others	1.28 (1.02 to 1.62)	0.034	1.6 (1.24 to 2.06)	<0.001	1.03 (0.83 to 1.28)	0.781	1.10 (0.86 to 1.41)	0.443
Religion								
Muslim	1.38 (1.20 to 1.59)	<0.001	1.14 (0.97 to 1.34)	0.113	1.42 (1.25 to 1.61)	<0.001	1.22 (1.04 to 1.45)	0.017
Other than Muslim	Ref				Ref			
Household size								
≤4	1.38 (1.20 to 1.59)	<0.001	1.14 (0.97 to 1.34)	0.119	1.42 (1.25 to 1.61)	<0.001	1.22 (1.04 to 1.45)	0.017

Continued

Table 3 Continued

Variables	Adolescent boys (n=4761)				Adolescent girls (n=4808)			
	Crude odds ratio (COR) (95% CI)	P value	Adjusted odds ratio (COR) (95% CI)	P value	Crude odds ratio (COR) (95% CI)	P value	Adjusted odds ratio (COR) (95% CI)	P value
≥5	Ref				Ref			
Less than 5-year-old household member								
Yes	Ref				Ref			
No	1.10 (0.93 to 1.29)	0.253	NA	NA	1.19 (1.04 to 1.38)	0.014	1.04 (0.88 to 1.23)	0.626
6–9-year-old household member								
Yes	Ref				Ref			
No	1.26 (1.08 to 1.47)	0.003	1.33 (1.12 to 1.57)	0.001	1.51 (1.31 to 1.75)	<0.001	1.30 (1.10 to 1.53)	0.002
Another adolescent household member								
Yes	Ref				Ref			
No	1.40 (1.22 to 1.60)	<0.001	1.34 (1.14 to 1.57)	<0.001	1.19 (1.04 to 1.35)	0.009	1.08 (0.93 to 1.26)	0.313
Elderly household member								
Yes	Ref				Ref			
No	1.02 (0.87 to 1.19)	0.815	NA	NA	1.08 (0.94 to 1.25)	0.272	NA	NA
Food security status of household								
Food secure	Ref				Ref			
Mild food insecurity	0.67 (0.56 to 0.80)	<0.001	0.63 (0.52 to 0.76)	<0.001	0.7 (0.59 to 0.82)	<0.001	0.77 (0.64 to 0.92)	0.003
Moderate food insecurity	1.14 (0.84 to 1.55)	0.397	1.12 (0.81 to 1.56)	0.485	1.26 (0.95 to 1.67)	0.108	1.33 (0.98 to 1.81)	0.066
Severe food insecurity	1.77 (1.46 to 2.15)	<0.001	1.44 (1.17 to 1.79)	0.001	1.62 (1.34 to 1.95)	<0.001	1.64 (1.33 to 2.02)	<0.001
Household use of fuel								
Clean	Ref				Ref			
Unclean	1.39 (1.17 to 1.66)	<0.001	1.39 (1.13 to 1.7)	0.002	0.95 (0.82 to 1.11)	0.534	NA	NA
Household wealth								
Richest	1.04 (0.84 to 1.28)	0.744	NA	NA	1.36 (1.11 to 1.66)	0.003	1.05 (0.83 to 1.33)	0.676
Richer	1.03 (0.83 to 1.28)	0.775	NA	NA	1.10 (0.90 to 1.35)	0.362	0.97 (0.78 to 1.21)	0.797
Middle	0.98 (0.79 to 1.22)	0.853	NA	NA	1.01 (0.82 to 1.24)	0.94	0.98 (0.79 to 1.22)	0.844
Poorer	0.94 (0.76 to 1.17)	0.604	NA	NA	0.99 (0.81 to 1.22)	0.943	0.99 (0.80 to 1.24)	0.960
Poorest	Ref				Ref			
<b>Lifestyle variables</b>								
Any tobacco use								
Yes	2.41 (1.85 to 3.15)	<0.001	2.17 (1.61 to 2.92)	<0.001	1.04 (0.54 to 2.02)	0.897	NA	NA
No	Ref				Ref			
Fruits and vegetables intake								
Insufficient (<5 servings per day)	1.17 (0.92 to 1.49)	0.205	NA	NA	0.90 (0.70 to 1.16)	0.412	NA	NA
Sufficient (≥5 servings per day)	Ref				Ref			
Processed food intake								
Yes	1.18 (0.98 to 1.41)	0.076	1.24 (1.02 to 1.50)	0.029	1.08 (0.93 to 1.25)	0.296	NA	NA
No	Ref				Ref			
Consumption of fortified oil								
Yes	Ref				Ref			
No	2.06 (1.74 to 2.43)	<0.001	1.87 (1.55 to 2.25)	<0.001	1.56 (1.35 to 1.80)	<0.001	1.61 (1.36 to 1.90)	<0.001
Consumption of iodised salt								
Yes	Ref				Ref			
No	2.00 (1.74 to 2.31)	<0.001	1.9 (1.61 to 2.23)	<0.001	1.71 (1.49 to 1.96)	<0.001	1.81 (1.54 to 2.12)	<0.001

Continued

Table 3 Continued

Variables	Adolescent boys (n=4761)				Adolescent girls (n=4808)			
	Crude odds ratio (COR) (95% CI)	P value	Adjusted odds ratio (COR) (95% CI)	P value	Crude odds ratio (COR) (95% CI)	P value	Adjusted odds ratio (COR) (95% CI)	P value
<b>Physical activity</b>								
Insufficient (<150 minutes of moderate or <75 minutes of vigorous physical activity or equivalent/week)	1.20 (1.04 to 1.39)	0.012	1.24 (1.06 to 1.46)	0.006	1.36 (1.19 to 1.54)	<0.001	1.44 (1.25 to 1.67)	<0.001
Sufficient (≥150 min of moderate or ≥75 minutes of vigorous physical activity or equivalent/week)	Ref				Ref			
<b>Television viewing time/day</b>								
None	Ref				Ref			
≤60minutes	1.06 (0.9 to 1.25)	0.47	1.07 (0.9 to 1.27)	0.463	0.86 (0.73 to 1.01)	0.061	0.99 (0.83 to 1.17)	0.889
61–120minutes	1.00 (0.82 to 1.23)	0.994	1.03 (0.83 to 1.28)	0.788	1.21 (1.01 to 1.44)	0.035	1.40 (1.16 to 1.69)	<0.0001
≥121 min	1.91 (1.51 to 2.42)	<0.001	1.95 (1.51 to 2.51)	<0.001	1.95 (1.58 to 2.39)	<0.001	1.99 (1.59 to 2.49)	<0.001
<b>Anthropometric variable</b>								
<b>Weight</b>								
<30 kg	Ref				Ref			
≤30–<50 kg	1.15 (0.96 to 1.39)	0.136	1.07 (0.87 to 1.32)	0.519	1.38 (1.12 to 1.7)	0.003	1.12 (0.87 to 1.45)	0.384
≥50 kg	1.01 (0.83 to 1.24)	0.902	0.82 (0.64 to 1.07)	0.145	1.74 (1.37 to 2.21)	<0.001	1.03 (0.76 to 1.40)	0.856

P value was significant at <0.05.

\*The cut-off of PHQ-9 score ≥5 was categorised as any depression for this analysis.

older adolescents may face more factors and triggers of depression due to increased autonomy and social adjustment.<sup>17</sup>

As reported in our study, investigators from India observed an association of depression with higher maternal and paternal education among school-going adolescents. The authors of the Indian study described three possible reasons behind the association. The educated parents have high expectations from their children; they force their children towards more academic activities instead of recreational activities; and they do not find time to spend with the children as they are involved with jobs or outdoor activities.<sup>6</sup> Investigators of a study in Pakistan described that parental bonding is crucial for the psychosocial functioning of any individuals.<sup>18</sup> In Bangladesh, the higher odds of depression among adolescent boys and girls having mothers with partial primary education, and among adolescent boys having mothers and fathers with partial or completed secondary education or higher can also be due to the reasons mentioned above.

Though the association between Islam religion and higher odds of depression found in our study surprised us, authors from Pakistan revealed an opposite association, that is, adolescents from religious minorities (Christians and Hindus) are more depressed than their dominant counterpart (Muslims).<sup>19</sup> A similar association

was reported by an Indian study in which the dominant religion was Hindu.<sup>20</sup> The investigators of the Pakistan study attributed the higher risk of depression among adolescents from religious minorities to a range of environmental and social conditions that prevailed due to marginalisation and oppression. As this is not the case for adolescent girls from the Muslim community in Bangladesh, there is a need for further research to find possible explanations behind this association found in our study.

The association between food insecurity and mental health disorders is also not uncommon. Investigators of a study implemented in the slums of India reported a strong association of food insecurity with depression (AOR: 13.96, 95% CI: 5.89 to 31.79).<sup>20</sup> Researchers from Pakistan also reported an association between food insecurity and antepartum depression.<sup>21</sup> However, these studies did not report the odds of having depression by the level of food insecurity. In our case, we revealed that mild food insecurity was protective against depression, whereas, severe food insecurity increased the odds of depression among both boys and girls. There is evidence that food insecurity generates stress connected to the uncertainty regarding the maintenance of food supplies.<sup>22</sup> Moreover, food insecurity can influence socioeconomic discrepancy and cultural sensitivity and can have a negative impact on mental health.<sup>23</sup> The protective effect of mild food insecurity can be because of the fact that a mild form of the

household problem may lead to an improved bonding between the members of a household, but further research is needed to ascertain this.

Researchers also investigated the association between the number of household members, presence of siblings and depression among the adolescents. We found that an absence of any 6–9-year-old members in the household (for both and girls) and an absence of at least another adolescent member in the household (for boys only) increased the odds of having depression. An Indian study reported a somewhat opposite association, that is, the presence of a sibling in the household increases the risk of depression and other selected mental health problems.<sup>20</sup> However, the authors of a study carried out among the youths of Bangladesh reported that living with family and spending time with parents reduce both anxiety and depression.<sup>24</sup> In our context, we think that the presence of another closed age member in the household may improve the sharing of life lessons, physical activity and thus lead to protection against depression.

Only among the boys, our analysis revealed that consumption of processed food was associated with an increased odds of depression and our findings are consistent with studies from Bangladesh and elsewhere.<sup>5 25</sup> Bishwajit *et al* reported that consumption of fewer than five servings of fruits or vegetables increases the odds of depression in Nepal, India and Bangladesh.<sup>25</sup> Khan *et al* reported that consumption of sugary drinks increases the odds of depression.<sup>5</sup> The authors of another recently published study implemented among Bangladeshi women in reproductive age group observed that consumption of Vitamin-A rich and Vitamin-C rich foods, eggs, dairy and fish are associated with lower odds of depression.<sup>26</sup> We also observed that household use of unfortified oil and non-iodised salt increased the odds of depression in both boys and girls. In Bangladesh, edible oil is fortified with vitamin A and or vitamin D. A study with the Japanese population reported that depressed individuals have a significantly low vitamin A level.<sup>27</sup> The association between vitamin D deficiency and depression is also well established,<sup>28 29</sup> and there is evidence that vitamin D supplementation can ameliorate depression in adolescents.<sup>30</sup> The relationship between poor mental health and iodine deficiency is also well known.<sup>31</sup> Though Bangladesh is implementing a universal iodisation of salt programme for decades, the coverage of adequately iodised salt is still 69% in urban and 44% in rural areas.<sup>32</sup> Our analysis suggests that salt iodisation may have the potential to improve the mental health of adolescents too.

Studies from Bangladesh<sup>7 33</sup> also reported the association of insufficient physical activity and high screen time with depression among adolescents. In our study, we did not measure the total screen time that includes all screen-based activities. However, we found that both insufficient physical activity and television viewing time ( $\geq 121$  minute/day for boys, and 61–120 minute and  $\geq 121$  minute for girls) increased the odds of having depression. Studies reported that high screen time is associated not only with

depression but also with anxiety, poor cognitive performance, behavioural problems, nervousness, sleep difficulties, attention deficit hyperactivity disorder, self-harm and social isolation among adolescents.<sup>34 35</sup> Physical activity can reduce depression and anxiety and enhance academic performance, self-esteem, quality of sleep and satisfaction in life.<sup>36 37</sup> Given the fact that reduced screen time and recommended level of physical activity lower the odds of depression and other psychologic difficulties,<sup>35 38 39</sup> there is an urgent need of intervention to increase physical activity and decrease screen time among adolescents.

Among the boys, we also observed that depression was associated with household use of solid-biomass fuel and tobacco use. The use of solid-biomass fuel can be considered as a proxy indicator of air pollution. Associations between depression and tobacco use have also been reported by other authors,<sup>40</sup> and there is evidence that smoking may enhance the effect of air pollution on depression.<sup>41</sup> Smoking has been reported as a factor associated with mental health disorders either as a cause or a consequence.<sup>42</sup> Due to the cross-sectional nature of this study, we cannot explain whether there is a reverse-causality concerning tobacco consumption. Moreover, the association between non-slum urban residence and depression among adolescent girls is consistent with findings from other studies.<sup>43</sup> The authors of a paper from Bangladesh also reported that people in semiurban areas have higher odds of depression than their rural counterparts.<sup>42</sup>

One of the strengths of the present study is that we included nationally representative samples of both adolescent girls and boys and the data were collected using face-to-face interviews. The large samples enabled us to run the statistical analyses separately for girls and boys *y*. However, the study had limitations. First, data on both outcome variable and many explanatory variable were collected based on self-report, which is prone to information bias. Given that this component of the study was included in a large nationwide survey, all the known variables that are associated with depression among adolescents could not be included in the data collection tools. Second, as mentioned earlier, this cross-sectional study cannot establish causal association between depression and the factors examined. Third, we did not collect any data on treatment-seeking practices of adolescents with depression. Lack of data on the treatment-seeking practices bars us from giving a comprehensive overview of the situation of depression among adolescents in Bangladesh. Therefore, there is a need for further studies to find ways to integrate care of depression among adolescents in the health system.

In conclusion, we can say that our analysis revealed a high prevalence of depression among adolescents though the prevalence of moderately severe and severe depression was low. The prevalence of depression was higher among adolescent girls than the boys across many sociodemographic, lifestyle and anthropometric strata. We also identified some modifiable and non-modifiable

factors associated with depression among the adolescents. The modifiable factors included food insecurity, household use of unfortified oil, household use of non-iodised salt, insufficient physical activity, high television viewing time, household use of solid biomass fuel and use of any tobacco products. While the health and other relevant sectors can address these factors, the non-modifiable factors, for example, age, maternal education, paternal education, religion, absence of adolescent or 6–9-year-old household members, parental occupation can be used to develop screening tools for identifying adolescents at high risk of depression. Given the high prevalence of depression among both girls and boys, there is a need for integrating mental health interventions in primary healthcare and arranging counselling services in the educational institutions. Since the government of Bangladesh has already identified mental health as a priority to improve health of the adolescents, this paper is expected to fill some of the existing knowledge gaps and help the government of Bangladesh design and implement interventions for improving the mental health of adolescents.

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**Acknowledgements** We are thankful to all the study participants, data collectors, data collection supervisors, members of the Technical Advisory Group and representatives of the national nutrition services other than the authors included in the paper.

**Contributors** MKM conceptualised the design of the study, led data collection, developed the statistical analysis plan, and drafted the initial manuscript. MdMH and AAMH managed data, carried out data analysis and reviewed the drafts of the manuscripts. MdSAK, MHa, DM, MHe, MAU, SKS, SMMR, MdMIB and AAS were involved in the conceptualisation and design of the study, supervision of data collection, as well as review and approval of the final version of the manuscript. MKM was the principal investigator of the study and approved the final version of the manuscript.

**Funding** The study was funded by the National Nutrition Services (NNS), Directorate General of Health Services, Ministry of Health and Family Welfare, Government of Bangladesh (Memo: 45.165.032.01.00.003.2016-325; date: 10 December 2017).

**Competing interests** Some of the representatives of the Ministry of Health and Family Welfare, who approved the funding of the study were involved with the Technical Advisory Group. Though they had opinions about some maternal and child health and nutrition indicators, they did not have any role in the design, conduct, data analysis and manuscript writing of the adolescent component of the study.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

**Patient consent for publication** Not required.

**Ethics approval** The study obtained ethical approval from the Institutional Review Board (IRB) of the BRAC James P Grant School of Public Health, BRAC University, Dhaka, Bangladesh (IRB Reference no: IR-2018-20).

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data will be available upon request. All such requests can be sent to IRB Chair, BRAC James P Grant School of Public Health, BRAC University, Dhaka, Bangladesh to the email address: irb-jpgsph@bracu.ac.bd.

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