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

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ABSTRACT

Objective To assess the prevalence of 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 adolescents 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 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.1 As per the latest census carried out in Bangladesh, adolescents comprise more than one-fifth of the total population.2 During adolescence, every human being experiences physical, psychological and social changes.1 As these changes occur simultaneously and rapidly, adolescence is considered a period of vulnerability.1 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 contrib-
utor to the global burden of disease. Depression can
also be common among adolescents. In adolescents and
young people, depression can increase the risk of poor
health, suicide, unhealthy lifestyle behaviour and poor
social well-being. There is also evidence that early life
depression is related to lower educational attainment.

Data from small studies revealed that there is a high
prevalence of depression among adolescents in Bangla-
desh. 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%). 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. 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 infor-
mation 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. The United Nations Population Fund
estimated that the proportion of adolescents in Bangla-
desh would continue to increase. 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 Bangla-
desh. 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 depres-
sion 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 depres-
sion 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, Mymen-
ingh, Rajshahi, Rangpur and Sylhet) and all types of resi-
dence (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 clus-
ters 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. In
the first stage, we identified slums with ≥300 house-
holds. 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 ≥250–300 households. We
randomly selected one cluster from each division, except
for Dhaka and Chattogram. As there are more slum popu-
lation in Dhaka and Chattogram, we eventually
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 adoles-
cents 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, α=0.05; margin of error, d=0.05 or p/2 when
p≤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 adoles-
cent 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 4,907 adolescent boys and 4,949 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 α=0.83) when used in Bangladeshi adolescents.

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). 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 ≥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, 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. We used WHO STEPS survey questions to collect data on lifestyle behaviour (use of tobacco products, physical activity and fruits and vegetable intake). 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.12 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 kg/m²), normal (BMI: 18.5–22.9 kg/m²) and overweight or obese (BMI≥23.0 kg/m²) using Asian cutoff for BMI.15

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

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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 (≤0.2) in the bivariate analysis. If any of the explanatory variable is highly correlated (correlation coefficient of ≥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 percent 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 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 ≥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 ≤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 ≤4, absence of a
### Table 1  Background characteristics of the study population by sex

| Sociodemographic characteristics | Whole sample (n=9856) | Adolescent boy (n=4907) | Adolescent girl (n=4949) |
|----------------------------------|-----------------------|-------------------------|--------------------------|
| **Age**                          |                       |                         |                          |
| 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)               |
| **Place of residence**           |                       |                         |                          |
| 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)               |
| **Educational status**           |                       |                         |                          |
| No education                     | 221 (2.24)            | 161 (3.28)              | 60 (1.2)                 |
| 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)               |
| **Maternal education**           |                       |                         |                          |
| 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)               |
| **Paternal education**           |                       |                         |                          |
| 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)                 |
| **Maternal occupation**          |                       |                         |                          |
| Housewife                        | 8499 (86.2)           | 4249 (86.6)             | 4250 (85.9)              |
| Other                            | 1357 (13.8)           | 658 (13.4)              | 699 (14.1)               |
| **Paternal occupation**          |                       |                         |                          |
| 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)              |
| **Marital status**               |                       |                         |                          |
| Currently married                | 725 (7.36)            | 43 (0.88)               | 682 (13.8)               |
| Others                           | 9131 (92.6)           | 4864 (99.1)             | 4267 (86.2)              |
| **Religion**                     |                       |                         |                          |
| Muslim                           | 8611 (87.4)           | 4272 (87.1)             | 4339 (87.7)              |
| Other                            | 1245 (12.6)           | 635 (12.9)              | 610 (12.3)               |
| **Household size**               |                       |                         |                          |
| ≤4                               | 5352 (54.3)           | 2725 (55.5)             | 2627 (53.1)              |
| ≥5                               | 4504 (45.7)           | 2182 (44.5)             | 2322 (46.9)              |
| **Less than 5-year-old household member** |               |                         |                          |
### Table 1  Continued

|                                      | Whole sample (n=9856) | Adolescent boy (n=4907) | Adolescent girl (n=4949) |
|--------------------------------------|-----------------------|-------------------------|--------------------------|
|                                      | Yes                   | No                      | Yes                      | No                      |
| 6–9-year-old household member        | 2688 27.3             | 7168 72.7               | 1173 23.9                | 3734 76.1               |
|                                      |                       |                         | 1515 30.6                | 3434 69.4               |
| Another adolescent household member  | 3043 31.8             | 6526 68.2               | 1475 31                   | 3286 69                 |
|                                      |                       |                         | 1568 32.6                | 3240 67.4               |
| ≥60-year-old household member        | 4789 48.6             | 5067 51.4               | 2399 48.9                | 2508 51.1               |
|                                      |                       |                         | 2390 48.3                | 2559 51.7               |
| Food security status of household    | 5680 57.7             | 2477 25.1               | 2817 57.4                | 1244 25.4               |
| Food secure                          | 2738 27.8             | 498 5.06                | 1360 27.7                | 248 5.06                |
| Mild food insecurity                 | 2895 29.5             | 1196 12.1               | 2863 57.9                | 595 12.1                |
| food secure                          | 7118 72.2             | 3043 31.8               | 3547 72.3                | 1360 27.7               |
| Household use of fuel                | 2155 21.9             | 7696 78.1               | 1074 21.9                | 3830 78.1               |
| Clean                                |                       |                         | 1081 21.9                | 3866 78.2               |
| Unclean                              |                       |                         | 20.1 21.9                | 995 20.1                |
| Household wealth                     | 1961 19.9             | 1972 20                 | 975 19.9                 | 983 20                 |
| Richest                              |                       |                         | 986 19.9                 | 20                    |
| Richer                               | 1970 20               | 981 20                 | 989 20                   | 20                    |
| Middle                               | 1969 20               | 981 20                 | 988 20                   | 20                    |
| Poorer                               | 1979 20               | 984 20                 | 995 20                   | 20.1 20.1              |
| Dietary diversity                    | 5293 53.7             | 4563 46.3               | 2553 52                  | 2354 48                 |
| Inadequate (<5 food groups per day)  |                       |                         | 52 2740 55.4             | 48 2209 44.6           |
| Adequate (≥5 food groups per day)    |                       |                         | 95 4903 99.1             | 4629 93.5              |
| Fruits and vegetable intake          | 9080 92.1             | 776 7.87               | 4451 90.7                | 456 9.29               |
| Insufficient (<5 servings per day)   |                       |                         | 90.7 4629 93.5           | 456 9.29               |
| Sufficient (≥5 servings per day)     |                       |                         | 93.5 4629 93.5           | 93.5 4629 93.5         |
| Processed food intake                | 7576 76.9             | 2280 23.1              | 3982 81.2                | 925 18.9                |
| Yes                                  |                       |                         | 3594 72.6                | 1355 27.4              |
| No                                   |                       |                         | 1529 30.9                | 27.4                   |
| Consumption of fortified oil        | 3013 30.6             | 6843 69.4              | 1484 30.2                | 3423 69.8              |
| Yes                                  |                       |                         | 1529 30.9                | 3420 69.1              |
| No                                   | 7115 72.2             | 2736 27.8              | 3526 71.9                | 1378 28.1              |
| Consumption of iodised salt         | 3589 72.6             | 1358 27.5              | 3589 72.6                | 1358 27.5              |
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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 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).

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

| Table 1 Continued |
|-------------------|
|                   | Whole sample (n=9856) | Adolescent boy (n=4907) | Adolescent girl (n=4949) |
| **Physical activity** |                 |                        |                          |
| 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 |
| **Sedentary time/day** |                 |                        |                          |
| ≤6 hours | 4122 | 41.8 | 2141 | 43.6 | 1981 | 40 |
| >6 hours | 5734 | 58.2 | 2766 | 56.4 | 2968 | 60 |
| **Television viewing time/day** |                 |                        |                          |
| 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 |
| **Anthropometric characteristics** |                 |                        |                          |
| **Height** |                 |                        |                          |
| <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 |
| **Weight** |                 |                        |                          |
| <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 |
| **Body Mass Index** |                 |                        |                          |
| 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 |

Figure 1: Prevalence of levels of depression among adolescent boys and girls.
| 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 |
| **Sociodemographic variables** | | | | |
| **Age** | | | | |
| 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 |
| **Place of residence** | | | | |
| 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 |
| **Educational status** | | | | |
| 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 |
| **Maternal education** | | | | |
| 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 |
| **Paternal education** | | | | |
| 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 |
| **Maternal occupation** | | | | |
| 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 |
| **Paternal occupation** | | | | |
| 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 |
| **Religion** | | | | |
| 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 |
| **Household size** | | | | |
| ≤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 |
| **Less than 5-year-old household member** | | | | |
| 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 |
| **6–10-year-old household member** | | | | |
| 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 36.65) | 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 (18.69 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 |
| **Lifestyle variables** | | | | |
| **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 (16.76 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 |
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). 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%). 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. Moreover, cultural practices and gender norms in South-Asian societies may make girls more vulnerable to depression. 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 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. There is a possibility that

| Table 2 Continued | Whole sample (n=9569) % (95% CI) | Adolescent boy (n=4761) % (95% CI) | Adolescent girl (n=4808) % (95% CI) | P value |
|-------------------|---------------------------------|-----------------------------------|-----------------------------------|---------|
| Sedentary time/day |                                 |                                   |                                   |         |
| ≤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   |
| Television viewing time/day |                |                                   |                                   |         |
| 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   |
| Anthropometric variables |                |                                   |                                   |         |
| Height            |                                 |                                   |                                   |         |
| <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   |
| Weight            |                                 |                                   |                                   |         |
| <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  |
| Body Mass Index   |                                 |                                   |                                   |         |
| 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.
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) | Adjusted odds ratio (COR) (95% CI) | P value | Crude odds ratio (COR) (95% CI) | Adjusted odds ratio (COR) (95% CI) | P value |
| 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) | Adjusted odds ratio (COR) (95% CI) | P value | Adolescent girls (n=4808) | Adjusted odds ratio (COR) (95% CI) | P value |
|------------------------------------------------|--------------------------|------------------------------------|---------|---------------------------|------------------------------------|---------|
| ≥5                                             | Ref                      |                                    |         | Ref                       |                                    |         |
| Less than 5-year-old household member          |                          |                                    |         |                           |                                    |         |
| Yes                                            | Ref                      |                                    |         |                           |                                    |         |
| No                                              | 1.10 (0.93 to 1.29)      | 0.253                              | 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                      |                                    |         |                           |                                    |         |
| 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                      |                                    |         |                           |                                    |         |
| 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                      |                                    |         |                           |                                    |         |
| No                                              | 1.02 (0.87 to 1.19)      | 0.815                              | NA      | 1.08 (0.94 to 1.25)      | 0.272                              | NA      | NA      |
| Food security status of household               |                          |                                    |         |                           |                                    |         |
| Food secure                                     | 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                      |                                    |         |                           |                                    |         |
| 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      | 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      | 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      | 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      | 0.99 (0.81 to 1.22)      | 0.943                              | 0.99 (0.80 to 1.24) | 0.960  |
| Poorest                                         | Ref                      |                                    |         |                           |                                    |         |
| Lifestyle variables                             |                          |                                    |         |                           |                                    |         |
| 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                      |                                    |         |                           |                                    |         |
| Fruits and vegetables intake                    |                          |                                    |         |                           |                                    |         |
| Insufficient (<5 servings per day)              | 1.17 (0.92 to 1.49)      | 0.205                              | NA      | 0.90 (0.70 to 1.16)      | 0.412                              | NA      | NA      |
| Sufficient (≥5 servings per day)                | 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                      |                                    |         |                           |                                    |         |
| Consumption of fortified oil                    |                          |                                    |         |                           |                                    |         |
| Yes                                             | 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                      |                                    |         |                           |                                    |         |
| 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
older adolescents may face more factors and triggers of depression due to increased autonomy and social adjustment.\(^{17}\)

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.\(^{6}\) Investigators of a study in Pakistan described that parental bonding is crucial for the psychosocial functioning of any individuals.\(^{18}\) 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).\(^{19}\) A similar association was reported by an Indian study in which the dominant religion was Hindu.\(^{20}\) 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).\(^{20}\) Researchers from Pakistan also reported an association between food insecurity and antepartum depression.\(^{21}\) 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.\(^{22}\) Moreover, food insecurity can influence socioeconomic discrepancy and cultural sensitivity and can have a negative impact on mental health.\(^{23}\) The protective effect of mild food insecurity can be because of the fact that a mild form of the

### Table 3

Continued

| Variables                  | Adolescent boys (n=4761) | Crude odds ratio (COR) (95% CI) P value | Adjusted odds ratio (COR) (95% CI) P value | Adolescent girls (n=4808) | Crude odds ratio (COR) (95% CI) P value | Adjusted odds ratio (COR) (95% CI) P value |
|----------------------------|--------------------------|----------------------------------------|------------------------------------------|--------------------------|----------------------------------------|------------------------------------------|
| Physical activity          |                          |                                        |                                          |                          |                                        |                                          |
| 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 | Ref | Ref |
| Television viewing time/day |                          |                                        |                                          |                          |                                        |                                          |
| None                       |                          |                                        |                                          |                          |                                        |                                          |
| ≤60 minutes                | 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 |
| 61–120 minutes             | 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 |
| Anthropometric variable    |                          |                                        |                                          |                          |                                        |                                          |
| Weight                     |                          |                                        |                                          |                          |                                        |                                          |
| <30 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.
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 girls and boys) 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.25 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.24 In our context, we think that the presence of another close aged 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.9 25 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.25 Khan et al reported that consumption of sugary drinks increases the odds of depression. 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.30 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.27 The association between vitamin D deficiency and depression is also well established,28 29 and there is evidence that vitamin D supplementation can ameliorate depression in adolescents.30 The relationship between poor mental health and iodine deficiency is also well known.31 Though Bangladesh is implementing a universal iodisation of salt programme for decades, the coverage of adequately iodised salt is still 69% in urban and 41% in rural areas.32 Our analysis suggests that salt iodisation may have the potential to improve the mental health of adolescents too.

Studies from Bangladesh7 33 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 (≥212 minutes/day for boys, and 61–120 minute and ≥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.34 35 Physical activity can reduce depression and anxiety and enhance academic performance, self-esteem, quality of sleep and satisfaction in life.36 37 Given the fact that reduced screen time and recommended level of physical activity lower the odds of depression and other psychologic difficulties,35 38 39 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,40 and there is evidence that smoking may enhance the effect of air pollution on depression.41 Smoking has been reported as a factor associated with mental health disorders either as a cause or a consequence.42 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.43 The authors of a paper from Bangladesh also reported that people in semiurban areas have higher odds of depression than their rural counterparts.42

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

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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.

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