PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Prevalence and associated factors of depression among adolescent boys and girls in Bangladesh: Findings from a nationwide survey
AUTHORS	Mridha, Malay Kanti; Hossain, Md Mokbul; Khan, Md Showkat Ali; Hanif, Abu Abdullah Mohammad; Hasan, Mehedi; Mitra, Dipak; Hossaine, Moyazzam; Ullah, Mohammad Aman; Sarker, Samir Kanti; Rahman, S M Mustafizur; Bulbul, Md. M. Islam; Shamim, Abu Ahmed

VERSION 1 – REVIEW

REVIEWER	Marianne Klemp
	University of Oslo, Norway
REVIEW RETURNED	18-May-2020
GENERAL COMMENTS	 Thanks for the possibility to review this paper. I think the authors show interesting results but I miss information on medication use by the adolescents. Since there is thorough information on nutrition etc, it would have been great to know if any of these boys or gurls used antidepressive medication and for how long. Another specific issue is that the paragraph on limitations is to weak. The paper would improve if the authors could expand on further limitations to the study such as using a self reporting tool, bias regarding reporting of depression level, severity, contact with health care, reatment and medication issues etc. This needs to be improved befor the paper can be accepted.

REVIEWER	Roger E. Thomas Faculty of Medicine, University of Calgary, Canada
REVIEW RETURNED	12-Oct-2020

GENERAL COMMENTS	This is an interesting, important and well performed survey Introduction You did not perform a comprehensive literature review of factors that predict depression in adolescents, especially factors relevant to Bangladesh. This would have permitted systematic testing of hypotheses and cued you to include the relevant measures in your survey. Data collection You clearly describe how you selected participants from rural, nonslum urban and urban slum clusters. Are there any publications of the national Census organization that provided
	detailed guidance for your sampling plan? And how do your sample results compare to national sampling reports? Census organisations usually provide detailed reports of problems in

constructing sampling frames and contacting respondents. How do
your sampling frames and results compare? (a) [You wrote: "For the selection of rural clusters, one district was
randomly selected from each division in the first stage of the four-
stage sampling. Afterward, two sub-districts were randomly
selected from the district. In the third stage, we randomly selected
32 unions (2 unions from each of the selected subdistrict). 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."]
(b) [You wrote: "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 these wards. In case one mahalla with >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 clusters. 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."]
(c) [You wrote: "For the selection of slum clusters, we used data
from the Census of Slum Areas and Floating Population 2014. 9 In
the first stage, we identified slums with \ge 300 households. If there were >500 households in any slums, we divided the slum into two
segments with a demarcated geographical boundary. Then, we
randomly selected 10 slums cluster, each with \ge 250-300
households. We selected one cluster from each division, except
for Dhaka and Chattogram. As there are more slums population in
Dhaka and Chattogram division, we selected two slums clusters
from each of them."]
How did your sampling experiences and difficulties in contacting
respondents differ across these three types of residential areas?
Sample size computation
[You wrote: "We determined the sample size to generate estimates at the national, divisional, and slums level. In the case of
adolescents and other population groups, we noticed that the
prevalence (p) of key variables were between 4% to 98%.
Considering the probability of Type I error, α =0.05; allowable
margin of error, d=0.05 or p/2 when $p \le 0.1$; design effect,
DEF=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 (5,580 in each group). In reality, from the 82 completed
clusters, we could collect data from 9,856 adolescents."] Please provide more detail about your power computation for the
three residential area types, and in particular how the "key
variables" were incorporated in your power computations.
Data collection
[You wrote: "In each cluster, we listed all eligible participants in the
households. Afterward, 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 4,907 randomly selected adolescent boys and 4,949 selected adolescent girls."]
What was the percentage of planned interviews that occurred in
each of your sampling frames?
Data completeness
You wrote: ["Five data collection teams, each comprising one supervisor and four or five data collectors were deployed. The
members of these teams were trained and standardized by the
investigators and field coordinators of the study."]
"To ensure data quality, the data collection supervisors re-
interviewed 5% of the interviewed households selected randomly
within 48 hours of the initial visit by the data collectors. The data collection supervisors also observed another 5% of the randomly
selected interviews."
In large surveys like this the number of supervisors, trainers, data
accuracy checkers and the thoroughness of training of
enumerators is crucial to achieving an excellent data completeness rate. For example in the WHO yellow fever
vaccination campaign in West Africa involving millions of patients
ascertainment of adverse vaccine effects was markedly hampered
by lack of the above personnel.
Results [You wrote: "We performed bivariate logistic regression to explore
the association between any depression and each of the
explanatory variables."]
Half of the items in the PHQ9 relate to psychological symptoms of
depression and half to physical symptoms. Did you separately
analyse the correlations with your explanatory variables? You wrote: "Our analysis revealed that depression was associated
with higher age, higher maternal education, paternal occupation,
e.g., business, being Muslim, absence of a 6-9 years old member
in the household, food insecurity, household consumption of
unfortified oil, household use of non-iodized salt, physical inactivity and high television viewing time among both boys and girls. Only
among boys, depression was also associated with 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, the non-slum urban residence was associated with depression."
Here you are handicapped by not having a prioritised list of
predictor variables from the literature to guide your analysis. Your
list of associations is very varied. Please comment on the relative
strengths of association between your variables and the prevalence and severity of depression. How does the
measurement of the variables (e.g. possible range of scores for
each variable) affect the strength of associations? Explain any
choices you made about cutting points.
Possible explanations of the results You provide some insightful ideas for correlations between some
of the variables related to your insights into Bangladeshi culture.
Please identify those supported by your data and those which are
insights from the literature. Examples are:
(a) "However, we found that both physical inactivity and television viewing time (≥121 min/d for boys and 61-120 minutes and ≥121
minutes for girls) increased the odds of having depression."
(b) "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

make girls more vulnerable to depression."
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VERSION 1 – AUTHOR RESPONSE

Reviewer(s)' Comments to Author:

Reviewer: 1

Reviewer Name: Marianne Klemp Institution and Country: University of Oslo, Norway Please state any competing interests or state 'None declared': None declared

Please leave your comments for the authors below

Comments: Thanks for the possibility to review this paper. I think the authors show interesting results but I miss information on medication use by the adolescents. Since there is thorough information on nutrition etc, it would have been great to know if any of these boys or gurls used antidepressive medication and for how long.

Response: Thank you for your comment. Unfortunately, we did not collect any data on the types and duration of anti-depressive medication.

Comments: Another specific issue is that the paragraph on limitations is to weak. The paper would improve if the authors could expand on further limitations to the study such as using a self reporting tool, bias regarding reporting of depression level, severity, contact with health care, reatment and medication issues etc. This needs to be improved befor the paper can be accepted.

Response: As suggested, we have added these limitations. Please see the inserted text in the discussion section of the revised manuscript.

Reviewer: 2

Reviewer Name: Roger E. Thomas Institution and Country: Faculty of Medicine, University of Calgary, Canada Please state any competing interests or state 'None declared': none declared

Please leave your comments for the authors below This is an interesting, important and well performed survey

Introduction

Comments: You did not perform a comprehensive literature review of factors that predict depression in adolescents, especially factors relevant to Bangladesh. This would have permitted systematic testing of hypotheses and cued you to include the relevant measures in your survey. Response: Thank you for your comment. We tried our best to search literature that were published from Bangladesh and we may miss some unpublished literature. During the revision of this paper based on your comments, we also updated our reference database. We could find some new papers about depression and suicidal ideation in general. Many of these papers on depression, anxiety and suicidal ideation are in the context of COVID-19. However, we found two papers from Bangladesh that are not COVID-19 related. The authors of one of these papers reported that among women in reproductive age, food insecurity, poor household food consumption, low dietary diversity and low-BMI increase the odds of depression. The study also found that consumption of dairy, eggs, fish, vitamin A-rich and vitamin-C rich foods was associated with reduced odds of depression (Sparling, Waid et al. 2020). The other study was carried out among the youths of Bangladesh and the authors reported that living with family, spending time with the parents, regular sleep and consumption of balanced diet not only lower stress but also reduces anxiety and depression (Arusha and Biswas 2020). We have now added relevant information from this paper in the discussion section of the revised paper. Please see the inserted text in track changes. However, we did not add this text in the introduction section.

Data collection

Comments: You clearly describe how you selected participants from rural, nonslum urban and urban slum clusters. Are there any publications of the national Census organization that provided detailed guidance for your sampling plan? And how do your sample results compare to national sampling reports? Census organisations usually provide detailed reports of problems in constructing sampling frames and contacting respondents. How do your sampling frames and results compare? Response: We presented the methodology of our study to the Bangladesh Bureau of Statistics and their suggestions were taken care of while implementing the study. As there are no national surveys on the adolescents, we could not compare our data and sampling errors with other studies implemented among adolescents. One of the national surveys that provides information on sampling errors is Bangladesh Demographic Health Survey (BDHS). In the recent BDHS that was completed in 2017-2018, the preliminary report does not contain information on sampling errors. As a result, we could not compare data regarding sampling errors with any of the national surveys.

(a) [You wrote: "For the selection of rural clusters, one district was randomly selected from each division in the first stage of the four-stage sampling. Afterward, two sub-districts were randomly selected from the district. In the third stage, we randomly selected 32 unions (2 unions from each of the selected subdistrict). 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."]

(b) [You wrote: "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 these wards. In case one mahalla with >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 clusters. 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."]

(c) [You wrote: "For the selection of slum clusters, we used data from the Census of Slum Areas and Floating Population 2014. 9 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 with a demarcated geographical boundary. Then, we randomly selected 10 slums cluster, each with \geq 250-300 households. We selected one cluster from each division, except for Dhaka and Chattogram. As there are more slums population in Dhaka and Chattogram division, we selected two slums clusters from each of them."]

Comments: How did your sampling experiences and difficulties in contacting respondents differ across these three types of residential areas?

Response: In any of the rural, non-slum urban or slums area, random selection of study cluster was not difficult. However, we faced different kinds of difficulties in these areas. In rural areas in general, carrying out household listing to generate the cluster specific sampling frame for the random selection of respondents was the easiest. We could carry out household listings easily and the respondents were more willing to cooperate with the survey team. In the non-slum urban areas, implementation of household listing was difficult as the survey team had to gain confidence from the owner of the building or the security personnel and the listing and interviews were also administered during odd hours of the day (e.g., at 9 PM) after the selected participant was back in the residence. We did not face much problems with household listing and interviews in the slum areas. For all the residential areas, organization of community sensitization meetings, development of verbal communication and telephone communication script and informal discussion with the locally influential people helped to reduce the barriers to the implementation of the survey.

Sample size computation

[You wrote: "We determined the sample size to generate estimates at the national, divisional, and slums level. In the case of adolescents and other population groups, we noticed that the prevalence (p) of key variables were between 4% to 98%. Considering the probability of Type I error, α =0.05; allowable margin of error, d=0.05 or p/2 when p ≤ 0.1; design effect, DEF=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 (5,580 in each group). In reality, from the 82 completed clusters, we could collect data from 9,856 adolescents."]

Please provide more detail about your power computation for the three residential area types, and in particular how the "key variables" were incorporated in your power computations.

Response: One of the key purposes of the study was to establish a surveillance system that can generate credible estimates on health and nutrition indicators periodically. As Bangladesh is divided into 8 administrative divisions, the other purpose of this survey was to generate estimates at divisional level. Accordingly, we selected 10 clusters from each of the eight divisions. The number of rural and non-slums urban clusters in each division was proportionate to the urban and rural population in the division. Given the fact that slum population is higher in Dhaka and Chittagong division, we randomly selected two slums from each of these two divisions. From the other divisions, we selected one slum from each. Table 1 outlines the stepwise detailing of the sampling techniques.

Administrative Units	Rural Area	Non-slum Urban	Slums Area
(number)		Area	
Division	8	8	8
Districts	16	8	Not applicable
Sub-district	16	Not applicable	Not applicable
Union/Ward	32	9	Not applicable
Clusters	64	16	10
Completed	57	15	10

Table 1: Cluster by administrative unit

From the study, our goals were to generate divisionally representative estimates of nutritional status of children (<5 years), adolescent boys (10-19 years), adolescent girls (10-19 years), adult men (20-59 years old), adult women (20-59 years old) and elderly population (males and females of 60 years and above). We looked at the health and nutrition indicators relevant to each of these groups. Those indicators ranged from 4% to 98%. For the estimates of proportion in which clusters are the unit of randomization, the minimum required sample size is determined by the following formula: $n = DEF X \{z_{\alpha/2}^{2}(p)(1-p)\}/d^{2}$

Where, DEF = the design effect

p = apriori proportion of the relevant indicator

 $z\alpha/2$ = Value of the standard normal variate allowing 100x α % probability of type I error.

d = allowable margin of error

In most of the surveys, the value of α is taken as 5%, d is taken as 5%. Theoretically, an apriori p=0.5 gave the largest sample size, since p(1-p) takes the highest value when p=0.5. However, the value of d=0.05 is not realistic when $p \le 0.1$. In these cases, we considered d=p/2. Since the lowest apriori proportion was 4% or 0.04, the value of "d" in this case was 2% or 0.02. Considering these assumptions, we needed 620 individuals in each group of population under study in each division (for p=0.5, d=0.05, DEF=1.61) and 600 individuals in each group of population under study in each division (for p=0.04, d=0.02, DEF=1.61). With a thought of 10 clusters in each division, there was a need for interviewing and taking the measurements of 62 0-5 years old children, 62 adolescent boys, 62 adolescent girls, 62 adult men (20-59 years old), 62 adult women (20-59 years old) and 62 elderly persons (>60 years) from each cluster. As per the census 2011, 10% of the people are 0-4 years old, 10% are adolescent boys, 10% are adolescent girls, 25% are adult men (20-59 years), 22% are adult women (20-49 years old), and 8% are above 60 years. Considering 4.4 members in each household, a 10% non-response rate, we determined that the minimum size of the cluster was estimated to of 250 households to interview or measure at least 62 subjects from each group. As the estimation of sample size was based on the reported prevalence on key health and nutrition variables, we wanted to see whether we were adequately powered to estimate odds ratio. Post hoc analysis suggests that we were adequately powered to carry out logistic regression to look into the association between different factors and depression. For example, the prevalence of depression was 20.8% among the reference group i.e. 10-14 years old boys. The estimated odds ratio was 1.44 in 18-19 years old boys. In order to calculate this odds ratio with 80% power we needed 382 subjects in the non-reference group but in reality, we had 538 subjects. Therefore, we think that we were powered to run logistic regressions.

Data collection

[You wrote: "In each cluster, we listed all eligible participants in the households. Afterward, 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 4,907 randomly selected adolescent boys and 4,949 selected adolescent girls."]

Comment: What was the percentage of planned interviews that occurred in each of your sampling frames?

Response: As per our survey database, we could interview 78% of the randomized respondents in the rural area, 74% in the non-slum urban areas, and 84% in the slums area. Data completeness

You wrote: ["Five data collection teams, each comprising one supervisor and four or five data collectors were deployed. The members of these teams were trained and standardized by the investigators and field coordinators of the study."]

"To ensure data quality, the data collection supervisors re-interviewed 5% of the interviewed households selected randomly within 48 hours of the initial visit by the data collectors. The data collection supervisors also observed another 5% of the randomly selected interviews."

Comment: In large surveys like this the number of supervisors, trainers, data accuracy checkers and the thoroughness of training of enumerators is crucial to achieving an excellent data completeness rate. For example in the WHO yellow fever vaccination campaign in West Africa involving millions of patients ascertainment of adverse vaccine effects was markedly hampered by lack of the above personnel.

Response: Thank you for your comment.

Results

[You wrote: "We performed bivariate logistic regression to explore the association between any depression and each of the explanatory variables."]

Half of the items in the PHQ9 relate to psychological symptoms of depression and half to physical symptoms. Did you separately analyse the correlations with your explanatory variables?] Response: No, we did not do separate analysis. As written in the methodology section, we treated depression as a dichotomous variable and categorized adolescents with PHQ score '0-4' as no depression, and PHQ score '5-27' as depression.

You wrote: "Our analysis revealed that depression was associated with higher age, higher maternal education, paternal occupation, e.g., business, being Muslim, absence of a 6-9 years old member in the household, food insecurity, household consumption of unfortified oil, household use of non-iodized salt, physical inactivity and high television viewing time among both boys and girls. Only among boys, depression was also associated with 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, the non-slum urban residence was associated with depression."

Comment: Here you are handicapped by not having a prioritised list of predictor variables from the literature to guide your analysis. Your list of associations is very varied. Please comment on the relative strengths of association between your variables and the prevalence and severity of depression. How does the measurement of the variables (e.g. possible range of scores for each variable) affect the strength of associations? Explain any choices you made about cutting points.

Response: During the design of the study and the development of the statistical analysis plan, we did a literature review to identify the factors associated with depression among adolescents and other population groups in Bangladesh. Though ours is the first nationwide study to report the factors associated with any depression by gender of the adolescents, we found some small-scale studies among adolescents. For example, the authors of a study in Dhaka city reported that among the adolescents in the secondary schools, depression was associated with being female, higher age, selfperception o non-normal weight, feeling unsafe at school, sleep disturbance, low life satisfaction, intake of sugary drink, and regular skipping of breakfast (Khan, Ahmed et al. 2020). From a study among the students in the university, the authors observed that poor or moderate self-rated health, self-rated body image dissatisfaction, underweight, overweight/obesity, hypertension, and hypotension are associated with depression (Hossain, Anjum et al. 2020). One study reported that among women in reproductive age, food insecurity, poor household food consumption, low dietary diversity and low-BMI increase the odds of depression. The study also found that consumption of dairy, eggs, fish, vitamin A-rich and vitamin-C rich foods was associated with reduced odds of depression (Sparling, Waid et al. 2020). Apart from the last study that was published after we wrote the paper, other studies were reviewed along with studies from South-Asia. Accordingly, in our paper, we explored association of depression with 3 different group of factors: socio-demographic, life-style, and anthropometric factors. Considering the biological plausibility, we explored the association of depression with some variables not reported in the literature (e.g. present or absence of an adolescent member in the household). We admit that all the variables identified during the literature search could not be included in the data collection tools since this component of the study was included in a larger data collection activity of understanding the nutrition status of the adolescents and five other population groups. We have now written about this limitation in the discussion section of the paper. Please see the revised text in track changes.

As written in the methodology section, we treated depression as a dichotomous variable and categorized adolescents with PHQ score '0-4' as no depression, and PHQ score '5-27' as depression. We did not run any logistic regression models to find association between the severity of depression and the factors examined. As described in the method section of the paper, we performed bivariate logistic regression to explore the association between any depression and each of the explanatory variables. 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 variables had a

correlation coefficient of ≥ 0.5 with another variable, we selected the variable that had the lowest pvalue in the bivariate analysis. We also carried out regression diagnostics to verify whether the underlying assumptions of regression models were met. We did not comment of the strengths of association based on the odds ratio. One of the reasons is that the population attributable risk of a factor associated with a disease or health condition not only depends on the strengths of association but also on the population prevalence of the risk factor. For example, in our case the odds ratio (OR) for having depression among any tobacco user adolescent boys was 2.17 but only 5% of adolescent boys consumed tobacco. On the other hand, the OR for having depression among the adolescent boys who consumed processed food was 1.24. If we assume that these OR are comparable with risk ratio, the population attributable risk of any tobacco use is 5.5% but for processed food intake is 15.6% though the OR of for processed food consumption is lower than any tobacco use.

Possible explanations of the results

You provide some insightful ideas for correlations between some of the variables related to your insights into Bangladeshi culture. Please identify those supported by your data and those which are insights from the literature. Examples are:

(a) "However, we found that both physical inactivity and television viewing time (≥121 min/d for boys and 61-120 minutes and ≥121 minutes for girls) increased the odds of having depression."

(b) "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."

(c) "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., socio-emotional) and physiological (e.g., hormonal) changes. Moreover, cultural practices and gender norms in South-Asian societies may make girls more vulnerable to depression."

Response: Thank you for your comment. Number (b) and (c) listed above are insights from the literature. These literatures are duly cited. Number (a) includes findings from our study but these findings are also supported by other literature.

VERSION 2 – REVIEW

REVIEWER	Roger E. Thomas Department of Family Medicine, University of Calgary, Alberta, Canada
REVIEW RETURNED	09-Dec-2020
GENERAL COMMENTS	The authors have responded in appropriate detail to all my suggestions and comments