Title: Prevalence and predictors of being overweight or obese among the married female adolescents in Bangladesh: An analysis of Bangladesh Demography and Health Survey 2014

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Introduction

Globally, the burden of being overweight/obese among adolescents has increased markedly and has become a significant public health challenge (Khan et al. 2019; Tanwi et al. 2019). Rapid urbanization and industrialization, higher economic growth, and food habits have been identified as causal predictors (Khan et al. 2019). Previous studies have shown that the prevalence of being overweight/obese in Bangladesh is increasing especially among females (Kamal et al. 2015; Sarma et al. 2016). A recent review reported that the prevalence rate among Bangladeshi children and adolescents was 1.0%-20.6% for being overweight and 0.3%-25.6% for being obese (Biswas et al. 2017). Being overweight/obese as an adolescent may cause serious health complications in future life, including cardiovascular disease, diabetes, and other co-morbidities such as depression, sleep apnea, etc. (Daniels 2009).

Previous studies have consistently demonstrated that obesity can be significantly associated with mental health problems including mood disorders (Faith et al. 2002; Stunkard et al. 2003), depression, and stress (Chu et al. 2019). Adolescents who are overweight can be ridiculed and often develop a poor self-image, which increases their risk of being bullied by peers (van Vuuren et al. 2019). Several studies have also shown that such victimization can be a mediator between body weight and mental health (Hoare et al. 2014; Russell-Mayhew et al. 2012).

Among females, research has also demonstrated that mental illness not only affects the maternal wellbeing but also has a significant effect on fetal outcomes (Gold & Marcus 2008) and nutritional status in later life (Haithar et al. 2018). Early identification of being overweight/obese among married female adolescents is important not only to protect their physical and mental health but also to protect perinatal and childhood outcomes (Santangeli et al. 2015; Gold & Marcus 2008; Haithar et al. 2018). To the best of the present authors' knowledge, no previous study has ever reported the prevalence and associated factors of being overweight/obese among married female adolescents in Bangladesh. Therefore, the present study investigated the prevalence and socio-demographic predictors of being overweight/obese among this group.

Method

Source of data and sample size: Data from the Bangladesh Demographic and Health Survey (BDHS) 2014 were used for analysis. The BDHS is a nationwide cross-sectional survey and data were collected using a two-stage stratified sampling method (Niport 2014). The present study extracted data from an adolescent sub-sample (aged 15-19 years) and removed the

missing cases. The final sample size was 2009 (weighted) for the present analysis. Details of the data extraction process are shown in Figure 1.

Dependent variable: For this analysis, the outcome variable was *being overweight/obese*, which was measured by the respondent's Body Mass Index (BMI). BMI was calculated from the respondent's height and weight, which were measured in a standardized way (Niprot, 2014). According to the World Health Organization (WHO), being overweight is when BMI ≥ 25.00 and obese is when BMI ≥ 30.00 (WHO 1997). In the present study, BMI ≥ 25.00 was considered as being overweight/obese.

Independent variables: Participants' demographic and socio-economic characteristics were considered as independent variables (i.e., predictor variables). The variables included in the analysis were: age (15-19 years), administrative division (Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet), type of place of residence (urban, rural), sex of the household head (male, female), family size (< 5, ≥ 5), wealth index (poorest, poorer, middle, richer, richest), education (no education, primary, secondary and higher), occupation (unemployed, employed), number of children (0, 1, 2+), and current breastfeeding status (no, yes).

Data analysis: Descriptive statistics were performed to calculate the frequency and percentage of the independent variables (i.e., socio-demographic variables). Chi-squared tests were performed to compare the prevalence of being overweight/obese according to different independent variables. The variables that were found significant in the chi-square test were then included in the regression model. Logistic regression models (adjusted and unadjusted) were used to assess the odd ratios (ORs). We used sampling weight to ensure the acceptability of the results at the national level. All statistical analyses were performed using the statistical software package STATA (version 14.2) and considered significant at $p<0.05$ level.

Results

The prevalence of being overweight/obese among adolescents was 7.5%. The prevalence was higher among adolescents who (i) were aged 19 years (χ^2 (df) = 18.18 (4), p=0.001), (ii) lived in a urban area (χ^2 (df) = 16.24 (1), p<0.001), (iii) had a higher wealth index (χ^2 (df) = 72.73 (4), p<0.001), and (iv) had a higher level education (χ^2 (df) = 40.05 (3), p<0.001). (Table 1). Table 2 illustrates the output of the regression analysis. The unadjusted model indicated that being aged 19 years (OR= 4.58, 95% CI: 1.75-11.97, p= 0.002); living in urban residence (OR= 1.99, 95% CI: 1.41-2.80, p<0.001); being in the richest wealth index (OR= 11.34, 95% CI: 4.99-25.78, p<0.001); and having a higher level of education (OR= 8.54, 95% CI: 2.26-32.26, p=0.002) were significant predictors of being overweight/obese among the sample. According to the adjusted model, being aged 19 years (OR= 3.33, 95% CI: 1.25-

8.85, p=0.016); being in the richest wealth index (OR= 6.96, 95% CI: 2.92-16.61, p<0.001); and having a higher level of education (OR= 4.64, 95% CI: 1.19-18.06, p=0.026) emerged as independent predictors of being overweight/obese among married teenage adolescent females.

Discussion

Findings from the present study indicate that a significant minority of married female adolescents were overweight/obese (7.5%). As noted earlier, being overweight/obese is associated with various mental health problems and can also affect fetal outcomes. Several demographic and economic predictors were identified as being significantly associated with being overweight/obese (i.e., older age, increased wealth, and higher educational status). As far as the present authors are aware, no previous has study has ever examined the prevalence of being overweight/obese among married female adolescents (either inside of outside of Bangladesh), therefore no comparisons with previous studies can be made. In the present study, older adolescents were more at risk of being overweight/obese which is consistent with findings from a previous Bangladeshi study (Alemu et al. 2014). Findings also showed that adolescents in the richest wealth quartile were also more likely to being overweight/obese compared to poorer adolescents. This is also similar to findings of a previous Bangladeshi study (Tanwi et al. 2019). Finally, adolescents with a higher educational status were more at risk of being overweight/obese, which is again similar to previous Bangladeshi findings (Tanwi et al. 2019).

The limitations of this study include the cross-sectional study design, and female-only sample (although by definition, males cannot get pregnant). Future in-depth studies including several behavior factors such as dietary practice, sleep quality, and internet/social media use in relation to mental health are recommended. The major strengths of the study include the large sample size and representativeness of the data.

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Ethical approval: Ethical approval for BDHS surveys has been received from the ICF International Institutional Review Board.

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Table 1. Characteristics of the study participants based on the prevalence of overweight and obesity, BDHS 2014.

Variables	Frequency %	Overweight or obesity	p value [1]
Age, years			0.001*
15	187 (9.3)	5 (2.7)	
16	247 (13.6)	17 (6.2)	
17	411 (20.4)	21 (5.1)	
18	546 (28.1)	47 (8.3)	
19	574 (28.6)	60 (10.5)	
Weight (kilogram) [a]	46.57 (8.03)		
Height (centimeter) [a]	151.03 (5.44)		
BMI (kg/m^2) [a]	20.38 (3.11)		
Division			0.397
Barisal	137 (6.8)	12 (8.8)	
Chittagong	397 (19.7)	28 (7.1)	
Dhaka	686 (34.2)	59 (8.6)	
Khulna	193 (9.6)	17 (8.8)	
Rajshahi	227 (11.3)	16 (7.0)	
Rangpur	242 (12.1)	15 (6.2)	
Sylhet	127 (6.3)	4 (3.1)	
Type of place of residence			<0.001*
Urban	535 (26.6)	61 (11.4)	
Rural	1474 (73.4)	89 (6.0)	
Sex of household head			0.325
Male	1826 (90.9)	133 (7.3)	
Female	183 (9.1)	17 (9.3)	
Family size			0.209
< 5	735 (36.6)	62 (8.4)	
≥ 5	1274 (63.4)	88 (6.9)	
Wealth index			<0.001*
Poorest	396 (19.7)	7 (1.8)	
Poorer	397 (19.8)	14 (3.5)	
Middle	436 (21.7)	27 (6.2)	
Richer	453 (22.6)	50 (11.0)	
Richest	327 (16.3)	53 (16.2)	
Education			<0.001*
No education	99 (5.0)	2 (2.0)	
Primary	537 (26.7)	22 (4.1)	
Secondary	1189 (59.2)	94 (7.9)	
Higher	183 (9.1)	32 (17.5)	
Occupation			0.168
Unemployed	1467 (82.0)	130 (7.9)	
Employed	362 (18.0)	21 (5.8)	
Children			
0	945 (47.0)	70 (7.4)	0.838

	1	977 (48.6)	72 (7.4)	
	2+	88 (4.4)	8 (9.1)	
Currently breastfeeding				
	No	1179 (58.7)	93 (7.9)	0.391
	Yes	830 (41.3)	57 (6.9)	

[1] *p*-value obtained from chi-square test

* Significant *p*-value ($p<0.05$)

[a] Data expressed as mean (standard deviation)

Table 2. Predictors of overweight and obesity among the married female adolescents in Bangladesh, BDHS 2014.

Variables	**Unadjusted**			**Adjusted** [1]		
	OR	95% CI	p value	OR	95% CI	*p*-value
Age, years						
15	1.00			1.00		
16	2.58	0.90-7.35	0.075	2.38	0.82-6.85	0.107
17	2.12	0.76-5.90	0.147	1.72	0.61-4.83	0.303
18	3.61	1.37-9.52	0.009*	2.83	1.06-7.57	0.038
19	4.58	1.75-11.97	0.002*	3.33	1.25-8.85	0.016*
Type of place of residence						
Urban	1.99	1.41-2.80	<0.001*	1.20	0.81-1.77	0.352
Rural	1.00			1.00		
Wealth index						
Poorest	1.00			1.00		
Poorer	2.07	0.81-5.29	0.128	1.67	0.65-4.31	0.285
Middle	3.79	1.60-8.98	0.002*	2.82	1.17-6.78	0.020*
Richer	7.30	3.21-16.60	<0.001*	5.03	2.15-11.76	<0.001*
Richest	11.34	4.99-25.78	<0.001*	6.96	2.92-16.61	<0.001*
Education						
No education	1.00			1.00		
Primary	1.66	0.43-6.38	0.457	1.64	0.42-6.42	0.476
Secondary	3.42	0.94-12.42	0.062	2.66	0.71-9.93	0.144
Higher	8.54	2.26-32.26	0.002*	4.64	1.19-18.06	0.026*

* Significant *p*-value ($p<0.05$)
[1] Adjusted with all the variables in the table

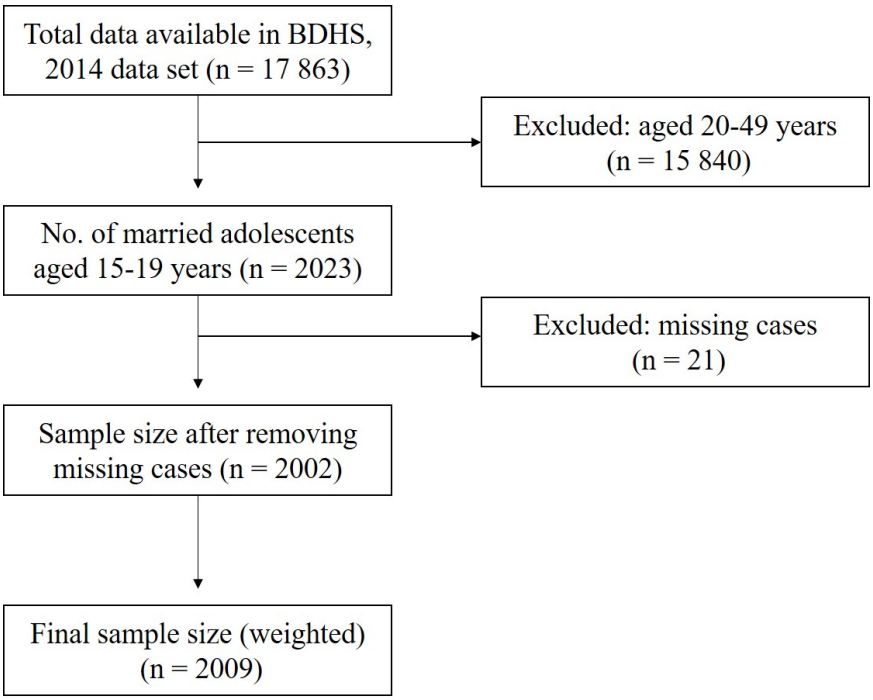

Figure 1. Schematic diagram of data extraction from BDHS 2014.