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Risk Factors of Grade 2 and 3 Obesity in Bangladeshi Children – A Hospital Based Study

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Abstract

Background: Obesity is a growing public health concern in Bangladesh

Aim: The aim of the study was to determine the risk factors of grade 2 and 3 obesity

Methods: This study was done in the Department of Endocrinology, BSMMU from May 2019 to March 2020 in children with primary exogenous obesity. Childhood obesity was classified using charts of the US Centers for Disease Control and Prevention. Risk factors (family, screen time, diet and physical activity domains) were assessed with an open ended structured questionnaire.

Results: The study included 189 children with a mean age of 12.27 ± 3.22 years and mean BMI of 29.61 ± 6.79 kg/m². Children with grade 2 and 3 obesity spent more time on computer/laptop/tablets due to academic purpose (2.07 ± 2.00 vs 0.33 ± 0.71 hours/day, p=0.029). After controlling for other factors, only duration of private tuition was related with BMI (β =0.883, p=0.02, 95% Cl=0.147-1.620). Sleep deprivation (z=1.332, SE=0.101, p=0.183) and screen time due to academic purpose (z=1.523, SE=0.282, p=0.128) were not mediators of private tuition and obesity. Duration of private tuition (OR=1.309, p=0.053, 95%Cl 0.997-1.721), private tuition duration > 1 hour/day times (OR=2.078, p=0.040, 1.034-4.173), screen time ≥2 hours/day (OR=5.732, p=0.021, 1.304-25.201), snacking (OR=11.872, p=0.033, 1.218-115.730), maternal obesity (OR=2.963, p=0.033, 1.094-8.023), maternal obesity and no access to playground (OR=1.463, p=0.009, 95% Cl=1.258-4.823) were independent predictors of grade 2 and 3 obesity.

Conclusion: Duration of private tuition, screen time, maternal obesity and snacking were risk factors of grade 2 and 3 obesity in children. Effect of private tuition on obesity was direct. Lack of access to playground was a risk factor only in those with a family history of maternal obesity.

Keywords: Private tuition; Screen time; Maternal obesity; Snacking; Playground; Childhood obesity; Risk factors

Introduction

Obesity is a major public health concern of the twenty first century because of its alarming increasing trend in both developed and developing countries [1]. Evidence from the non-communicable disease risk factor survey Bangladesh 2010 has shown that 17.6% of the Bangladeshi population are overweight and obese and noticed that urban population (25.1%) are more prone to the problem than rural population (10.2%) [2]. An upward trend in overweight and obesity among Bangladeshi children, adolescents, and adults were observed in a systematic review where overweight and obesity were much higher in girls than in boys among children and adolescents and also higher in females than in males in the adults [3].

There is complex interaction of genetic, metabolic, hormonal, environmental, socio-cultural and psychological factors in the pathogenesis of obesity. Body mass index is 25-40% heritable and genetic factor accounts for less than 5% cases of childhood obesity [4]. Dietary habit is one of the most important risk factors causing overweight and obesity in children and adolescents. Low nutrient energy foods and beverages are associated with childhood overweight and obesity [5,6]. Unhealthy food habit such as junk or fast foods, sugary beverages and skipping breakfast increase the risk of being overweight and obese [7]. On the other hand, fruits and vegetables, cereals and dairy products are protective against overweight and obesity [8]. Sedentary lifestyle is another important contributor to the development of obesity [9]. A study among Swedish school children showed that low physical activity played a role in developing abdominal obesity [10]. Use of screen-based sedentary behaviors such as watching television, playing video games, using smartphone/computer is positively related to childhood obesity [11]. Short sleep duration are bad sleep behavior are also risk factors for developing childhood obesity [12,13]. In developed countries socioeconomic status is inversely related to childhood obesity but in developing countries, the opposite relationship is observed [14]. Children of urban family are more likely to be overweight/obese [15]. Socio-cultural and family factors have significant association with obesity [16]. Our society regards food as reward and also as part of socializing [17]. This increases unhealthy relationship with food,

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thereby increasing the risk of obesity. Family factors such as low parental education, family history of obesity, overweight mother and single parent are risk factors for childhood obesity [18,19]. The amount and type of food consumed in family and family habits of activity also influence a child's weight [17].

Obesity has been declared an epidemic in many high-income countries. Its incidence in developing countries like Bangladesh is also on the rise. Obesity has substantial impact on reducing life expectancy and quality of life chiefly due to the development of diabetes and cardiovascular complications [20]. The risk factors of obesity have been investigated in different countries. However, risk factors of obesity have not been assessed in details in Bangladesh. It is important to investigate the risk factors of obesity in our country, especially in children as our lifestyle differs from other countries in several aspects. Furthermore, a study by our group showed that blood pressure and insulin resistance were significantly higher in children with grade 3 vs grade 1 obesity [21]. Here, we have looked at certain factors which are prevalent and common in our country to assess if they are increasing the risk of obesity, especially grade 2 and 3 obesity. This will aid development of preventive policies and national guidelines targeting factors increasing obesity in our population. Therefore the aim of the study was to determine the risk factors of primary exogenous obesity. Specifically, we wanted to identify the frequency of risk factors, their association with obesity and predictors of grade2 and 3 obesity in children.

Subjects

Children between 3-18 years of age with primary exogenous obesity were included. Those with secondary cause of obesity, such as endocrinopathies (hypothyroidism, Cushing's syndrome, hypothalamic disorders), genetic syndromes (Prader-Willi, Laurence-Moon-Biedl syndromes) and on weight gaining drugs (glucocorticoids, antipsycotics, anticonvulsants) were excluded. Secondary causes of obesity were excluded clinically and with thyroid function test.

This was a retrospective study, where data was obtained from hospital records. Consent for participation was obtained from the parents and children participating in the study. The study was approved by the Institutional Review Board (IRB) of Bangabandhu Sheikh Mujib Medical University (BSMMU) [registration number 651].

Material and Methods

This retrospective cross-sectional study was done in the Department of Endocrinology, BSMMU from May 2019 to March 2020 in 189 participants.

Risk factors in overweight and obese individuals were assessed. Childhood and adult obesity were classified using growth charts of the US Centers for Disease Control and Prevention (CDC) for BMI [22]. Primary exogenous obesity was defined as obesity of exogenous origin not caused by endocrine, genetic or hypothalamic disorders [23]. Height was measured with a wall mounted stadiometer and weight

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	Table 1: Risk factors of obesity and their operational definition.
Risk factor	Operational definition
Family related factors	
Residence	The area/locality where participant resides. It will be divided into urban and rural. City/town will be considered as urban and all others as rural.
Parental BMI	Will be calculated from measured or self-reported height and weight.
Parental education	It will be divided into graduate (above HSC) and not graduate (HSC and below) [24].
Parental occupation	Profession of each parent. It will be divided into professional/managerial (having training or skill) and non-professional (no training/ skill/not working).
Family expenditure	Will be quantified in taka from gross monthly expenditure in basic expenses such as expense in lodging, foods, transportation, clothing etc.
Having car	
Having helping hand	
Device and sleep related	
Having own device	Eg. smart phone/computer/laptop/tablet
Screen time	Time spent in 24 hours on screen based electronic devices. Divided into (i) using smart phone for other than talking, (ii) using computer/laptop/tablet for academic purpose, (iii) using computer/laptop/tablet for nonacademic purpose and (iv) watching TV. Screen time will be divided into \geq 2 hours and $<$ 2 hours [25].
Bed time	Time at which they go to bed to sleep.
Waking time	Time of waking in the morning.
Daytime sleep	
Duration of sleep	Sleep duration will be calculated as duration of sleep in 24 hours. Sleep duration will be divided into ≥ 8 hours and < 8 hours [26].
Activity related factors	
Access to playground	Either at school or in the neighborhood.
Coaching duration	Time spent in tutor based programs (apart from school) for academic purpose.
Physical activity	Any bodily movements caused by skeletal muscle that requires energy expenditure [27].
Food related factors	
Missed meal	
Snacking	Consumption of extra meals
Consumption of energy dense food	High calorie food (eg sweets, fried food)
Consumption of beverages	Drink other than water
Eating fruits	
Eating out	Eating out > 3 times a month
Purchased school lunch	
Media during meals	
Family meals	
Meal location	Eating anywhere except dining room

SSC-secondary school certificate, HSC-higher secondary school certificate, BMI- body mass index.

with the same weighing scale during the clinical visit. An open-ended structured questionnaire was used to assess the risk factors of obesity filled by the same investigator (Table 1). Data were gathered from hospital records. Sample size was calculated for logistic regression, taking into account the number of risk factors. Recall bias was not accounted for.

Data were analyzed using IBM SPSS for Windows (Version 28.0. Armonk, NY: IBM). All values were expressed as means \pm SD or frequencies. Distributions of continuous variables were examined for normality. Student's independent t test was done to see the difference between overweight and grade 1 vs grade 2 and grade 3 obesity. Pearson's correlation and multiple linear regression tests were done to determine the relation between BMI and risk factors. Logistic regression (backward conditional method) was done to determine the predictors of grade 2 and grade 3 obesity. A p-value of ≤ 0.05 was considered statistically significant.

Results

The mean age of 189 participants was 12.27 ± 3.22 years and mean BMI was 29.61 ± 6.79 kg/m². 36.5% were females. Majority of the children had grade 1 obesity (43.9%), followed by grade 2 obesity (30.7%). 12.7% were overweight and had grade 3 obesity. There was no difference of age (p=0.734) or gender (p=0.215) between those with overweight and grade 1 obesity vs grade 2 and 3 obesity.

The mean value and frequencies of risk factors are shown in Table 2 and Table 4 respectively. The mean screen time was greater than the recommended time (3.3 hours/day), with a maximum of 22 hours a day. 49.10% of the screen time was spent watching television, 41.60% on smart phones other than calling and 4.30% on computers. The maximum duration of private tuition was 7 hours a day. 16.4% and 38.1% did not have a playground in their neighborhood and school, respectively.

Children with grade 2 and 3 obesity spent more time on computers/ laptops/tablets for academic purpose and in private tuition than those with overweight and grade 1 obesity (Table 2).

There was a positive correlation between BMI and duration of smart phone use other than calling, duration of private tuition; and a negative correlation with bedtime (Table 3). In simple linear regression, when duration of smart phone use other than calling and private tuition increased by 1 unit, BMI increased by 0.914 kg/m2 (β =0.914, p=0.004) and 0.840 kg/m2 (β =0.840, p=0.026) respectively. When bedtime decreased by 1 unit, BMI increased by 0.003 kg/m2 (β =-0.003, r<0.001). In multiple linear regressions, when accounting

for all other continuous variables, only duration of private tuition was significantly related with BMI. For every unit increase in the duration of private tuition, BMI increased by 0.883 kg/m2. 12.8% of the variance of BMI was due to duration of private tuition. Sobel test indicated that sleep deprivation (z=1.332, SE=0.101, p=0.183) and increased screen time for academic purpose (z=-1.523, SE=0.282, p=0.128) were not mediators of the relationship between private tuition and obesity.

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Duration of private tuition was > 1 hour/d, maternal obesity, screen time was \geq 2 hours/day and snacking were independent predictors of grade 2 and 3 obesity (Table 4). If duration of private tuition increased by 1 unit, risk of grade 2 and 3 obesity increased 1.309 times. If screen time increased by 1 unit, risk of grade 2 and 3 obesity increased 1.393 times. Screen time of more than 1, 3 and 4 hours/day did not increase the risk of grade 2 and 3 obesity (OR 1.419, p=0.536, 95% CI=0.119-0.793; OR 0.353, p=0.030, 95% CI=0.138-0.905; OR=0.635, p=0.412, 95% CI=0.215-1.877) respectively. When a combination of factors were assessed, only presence of maternal obesity together with no access to playground increased risk of grade 2 and 3 obesity by 46.3% (p=0.009, 95% CI=1.258-4.823).

Duration of private tuition had a strong correlation with duration of computer/laptop/tablet use for academic (r=0.76, p=0.028) and nonacademic purpose (r=0.77, p=0.026). Duration of private tuition was also related to duration of sleep (r=-0.308, p=0.004) and maternal BMI (p=0.325, p=0.011). Duration of computer/laptop/tablet use for nonacademic purpose had a strong negative correlation with bedtime (r=-0.92, p<0.001) and duration of sleep (r=-0.65, p=0.031). A higher frequency of children with a screen time of \geq 2 hours go to bed after 10 pm (59.09% vs 38.18%, p<0.001), sleep < 8 hours/d (63.83% vs 34.04%, p<0.001), do not participate in physical activity (54.84% vs 43.47%, p<0.001) and do not have access to a playground (49.28% vs 38.71%, p<0.001).

Discussion

Duration of private tuition, screen time, maternal obesity and snacking were risk factors of grade 2 and 3 obesity in children. The effect of private tuition was direct, and not due to mediators such as sleep deprivation and screen time. The type of device used, such as smart phones and computers/laptops/tablets had a significant impact on severity of obesity. Children with a family history of obesity were affected by lack of access to a playground.

Duration of private tuition, especially private tuition for > 1hour/ day was significantly associated with obesity in children. Furthermore, private tuition was associated with less sleep and more screen time

Table 2: Risk factors of obesity in children (n=189).							
Variable	Total (n=189)	Overweight and grade 1 obesity (n=107)	Grade 2 and 3 obesity (n=82)	P value			
Father's BMI (kg/m²)	26.33 ± 3.84	26.45±3.82	26.16±3.92	0.717			
Mother's BMI (kg/m²)	28.03 ± 4.21	27.89±4.46	28.28±3.79	0.660			
Family expenditure (US\$)	319.68±220.30	303.39±147.74	346.20±46.36	0.318			
Family members	4.68 ± 1.48	4.64±1.57	4.73±1.35	0.783			
Screen time (hrs / d)	3.30 ± 3.21	3.03±2.90	3.66±3.56	0.213			
Duration of computer/laptop/tablet use for academic purpose (hrs / d)		0.33 ± 0.71	2.07 ± 2.00	0.029			
Bedtime	2075 ± 0630	2103±610	2036±660	0.507			
Waking time	0693 ± 0126	7.15±1.25	6.61±1.23	0.008			
Sleep duration (hrs / d)	8.44 ± 1.24	8.54±1.17	8.30±1.32	0.225			
Duration of private tuition (hrs / d)	2.58 ± 1.63	2.32±1.26	3.02±2.04	0.077			

BMI- body mass index, Student's t test

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		BMI	FB	MB	FF	FM	SP	ST	BT	wт	DS	DP
BMI	r	1	0.096	0.071	0 126	0.041	0 259	0 116	-0 276	-0.075	-0 118	0 240
Dim	p	•	0.346	0.484	0.185	0.659	0.004	0.128	<0.001	0.343	0.138	0.026
	n		98	100	113	120	122	173	161	161	160	86
FB	r		1	0.370	0.103	0.008	-0.103	-0.050	0.059	-0.123	0.015	0.077
. 5	р			< 0.001	0.323	0.937	0.389	0.630	0.563	0.229	0.885	0.563
	n			93	94	97	72	96	97	97	97	59
MB	r			1	0.348	0.018	-0.201	-0.014	-0.088	-0.127	-0.123	0.325
	р				0.001	0.857	0.093	0.892	0.389	0.209	0.225	0.011
	n				95	98	71	97	99	99	99	60
FE	r				1	0.195	0.024	0.092	-0.214	0.100	0.108	0.082
	р					0.039	0.827	0.337	0.023	0.292	0.256	0.514
	n					113	111	111	112	112	112	65
FM	r					1	0.076	0.068	0.133	0.051	-0.037	-0.097
	р						0.478	0.469	0.154	0.585	0.696	0.425
	n						89	116	117	117	117	70
SP	r						1	0.701	-0.210	0.180	0.037	-0.024
	р							<0.001	0.025	0.056	0.693	0.856
	n							122	114	114	114	62
ST	r							1	-0.187	0.112	-0.093	-0.044
	р								0.019	0.164	0.249	0.692
	n								157	157	156	84
BT	r								1	-0.216	0.044	-0.019
	р									0.006	0.581	0.864
	n									101	160	80
VV I	r									1	0.479	0.152
	p										<0.001	0.162
D 0											100	00
DS	r										1	-0.308
	p n											0.004
חח	- 11 - F											1
1/5												1
51	n											

r = Pearson's correlation coefficient, β = regression coefficient, FB= father's BMI, MB= mother's BMI, FE=family expenditure, FM= family member, SP= duration of smart phone use, ST= screen time, BT= bedtime, WT= waking at morning, DS= duration of sleep, DP= duration of private tuition

Table 4: Logistic regression with grade 2 and 3 obesity as dependent variable (n=189).

Independent risk variables	Frequency (%)	Odds ratio	p value	95% CI
Maternal obesity (BMI >30 kg/m ²)	30	2.936	0.033	1.094-8.023
Paternal obesity (BMI >30 kg/m ²)	19.39	0.324	0.198	0.058-1.799
Mother graduate	22.22	0.873	0.929	0.044-17.328
Father graduate	33.01	2.023	0.294	0.543-7.542
Mother professional	3.67	0.186	0.123	0.022-1.580
Father professional	11.21	1.040	0.579	0.226-4.787
Family expenditure > US\$318	41.59	0.284	2.063	0.549-7.750
Having car	2.14	0.943	0.968	0.054-16.548
Having a housekeeper	17.02	0.581	0.251	0.230-1.468
Missed meal	30.54	0.346	0.257	0.055-2.168
Snacking	75.16	11.872	0.033	1.218-115.730
Consumption of energy dense food	78.13	0.654	0.713	0.068-6.299
Consumption of beverages	70.12	0.916	0.927	0.140-5.978
Not eating fruits	21.95	1.091	0.938	0.122-9.728
Eating out > 3 times/month	40.58	0.264	0.057	0.067-1.042
Purchased school lunch	50	1.541	0.583	0.329-7.216
Media during meals	39.44	1.666	0.580	0.211-11.055
No family meals	17.88	1.950	0.579	0.184-20.630
Meal location outside dining room	30.47	3.235	0.149	0.658-15.908
Having own device	20.11	0.363	0.098	0.109-1.205
Duration of screen time	-	1.393	0.049	1.001-1.937
Screen time ≥ 2 hours	54.43	5.732	0.021	1.304-25.201
Bed time after 10 pm	68.32	0.415	0.128	0.134-1.288
Waking time after 7 am	29.81	2.259	0.153	0.739-6.910
Sleep < 8 hours/d	29.38	0.910	0.883	0.258-3.206
No access to playground	19.14	1.647	0.721	0.106-25.534
Duration of Private tuition	-	1.309	0.053	0.997-1.721
Duration of private tuition was >1 hr / d	54.5	2.078	0.040	1.034-4.173
No physical activity	39.88	0.961	0.934	0.376-2.548

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on computers. However, the effect of private tuition on obesity was a direct effect. A study in Mauritius showed that 9-10 year old children attending schools with high academic attainment had higher BMI. The authors postulated that this may be because these children attended more private tuition [24]. Another study in Sri Lanka also found an association between childhood obesity and grade five-scholarship examination. These children spent an average of 6.6 hours/per week on private tuition and 9 hours/week on academic activities at home [25]. Similar to our findings, these studies showed a negative impact of private tuition on weight. The association between private tuition and obesity is compounded by increased sedentary lifestyle, more screen time and less sleep and physical activity. A limitation of this study is that we did not estimate the duration of physical activity.

Screen time \geq 2 hours/day increased the risk of grade 2 and 3 obesity. Among the different types of devices used, smart phone use other than calling and a computer/laptop/tablet use for academic purpose were related with obesity. Furthermore, increased screen time, particularly watching computer/laptop/tablets for nonacademic purposes was associated with going to bed late and having less sleep. Our study also showed that lack of access to playground and lack of physical activities were associated with increased screen time. It is well known that screen time is a risk of obesity. A meta-analysis of 16 studies showed that screen time of \geq 2 hours was associated with 1.67 times risk of obesity. This association was stronger for watching television and computers [26]. Increased screen time was associated with changes in BMI at the upper end of the spectrum only. This means that screen time has a greater impact on children who are overweight/ obese [27]. The authors postulated that screen time may contribute to obesity by increasing inactivity and snacking. Our study showed a stronger influence of screen time on grade 2 and 3 obesity. The study also demonstrated that use of devices other than television such as smart phone and computers were individually associated with obesity in children. It is important to look into the different types of screen time, as there has been a decreasing trend in television watching [28] and increase in the use of other devices [29]. Children are the main users of new devices such as smart phones, computers and video games. Moreover different devices have different underlying mechanisms for causing obesity [30].

Among all the familial factors, only maternal obesity (BMI>30 kg/m²) increased the risk of grade 2 and 3 obesity in children. Moreover, presence of maternal obesity and lack of access to playground was also associated with increased risk of severe obesity. Lack of access to playground alone was not a risk factor. However, when genetic influence was taken into consideration, the risk became significant. This is in accordance with other studies that found having an overweight mother increases the likelihood of childhood obesity [31]. This may be due to not only genetic factors, but also lifestyle and eating patterns of the family. We were not able to look at the genetic influence of obesity separately in this study.

Advancing technology and rapid urbanization have had a tremendous impact on our lifestyle. It has generated new risk factors of obesity.

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