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Changing Trend of Overweight and Obesity and Their Associated Factors in an Urban Population of Bangladesh[*]

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ABSTRACT

There is a scarcity of information examining the prevalence of overweight and obesity in the general population of Bangladesh. Thus, the present study aimed to estimate the changing trends and socio-demographic characteristics of overweight and obese individuals among an urban population in Dhaka, Bangladesh. The present study included data from 49,532 patients enrolled in the Diarrheal Disease Surveillance System (DDSS) at the Dhaka Hospital from 1993-2011. Overweight and obese was categorized among under-5 children (n = 508), 5 - 19 years (n = 96), and >19 years (n = 1330). Data was compared with normal weight and malnourished individuals of respective age strata. The proportion of overweight and obese increased from 0.64% - 5.15% among children <5 years (chi-square for trend p < 0.001), 0.80% - 6.70% among 5 - 19 years (p < 0.001), and 3.66% - 16.94% (p < 0.001) among >19 years. Among those under-5, males [OR = 1.31 (95%CI 1.08, 1.57)] those with higher socio-economic status [1.99 (1.02, 3.82)], higher monthly mean family income [3.76 (2.41, 5.86)], non-slum residence [2.01 (0.74, 5.51)], high maternal literacy rate [3.66 (2.31, 5.79)], and using sanitary toilet [1.47 (1.07, 2.01)] were at higher risk of being overweight and obese compared to well-nourished and malnourished children. Among individuals 5 - 19 years, those with higher socioeconomic status and use of sanitary toilet were at higher risk of being overweight and obese. Among those >19 years, additionally males were less likely to be overweight and obese [0.59 (0.49, 0.68)]. Over the last two decades the prevalence of overweight and obesity in Dhaka city has increased at least five folds and it was much higher among those with better socioeconomic status.

Keywords: Bangladesh; Obesity; Overweight; Urban

1. Introduction

The prevalence of overweight and obesity has steadily increased over the last three decades in most low, middle and high income countries. Obesity is considered as a major health problem, and is associated with serious chronic conditions including diabetes mellitus, hypertension, stroke, cardiovascular disease, and some forms of cancer [1-4]. The World Health Organization (WHO) estimates that by the year 2015, approximately 2 - 3 billion adults will be overweight and of these, 700 million will be obese [5]. Although obesity is generally believed to be a problem among people in higher or middle class living in urban areas, the burden has started shifting towards the poor and rural populations, globally [6]. Due to the higher risk of chronic disease morbidity and mortality, obesity places a large financial burden on the national economy [5,7]. Additionally, obesity is associated with a large psychological burden [8,9].

Overweight and obesity have reached epidemic proportions in many countries in Asia [10]. Importantly, some Asian nations are experiencing a shift towards overweight and obese at a much younger age, compared to those in the Western countries [10]. Among Asian countries, Thailand has the highest rate of obesity, and India has the lowest rates [10]. The prevalence of over-

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weight and obesity is rapidly increasing in China [11], where the prevalence of overweight has increased from 5.3% to 13.6% among men and 9.8% to 14.4% in women between 1992 and 2002 [12].

To date, there is limited peer-reviewed literature describing the prevalence of overweight and obesity in Bangladesh. Research suggests that the rate of overweight and obesity among urban Bangladeshi women in the reproductive age group increased from 2.7% in 1996 to 8.9% in 2006 [13]. A recent study noted that prevalence of obesity was 17.9% amongst urban school-going children, with higher prevalence among males in this group (19.9%). Importantly, the highest rate of obesity (27.7%) was observed among 6 - 9 year olds [14]. However, there is no such data that indicated the changing trend of overweight and obesity in urban general population in Bangladesh.

Within this context, the present study aimed to assess the burden of overweight and obesity among an urban general population who visited the largest diarrheal disease hospital in the capital city, Dhaka, Bangladesh. The study also aimed to determine the socio-demographic characteristics of overweight and obese individuals, and the changing trends in prevalence over the last two decades.

2. Materials and Methods

2.1. Study Site, Source of Data and the Hospital Surveillance System

The study was conducted at the Dhaka Hospital of the International Centre for Diarrheal Disease Research, Bangladesh (icddr,b), located in Dhaka, the capital city of Bangladesh. Established in 1962, this hospital currently provides free care and treatment to around 140,000 patients each year, irrespective of age and sex. A Diarrheal Disease Surveillance System (DDSS) has been established at the hospital since 1979, to collect longitudinal data on the hospital's patient populations. The DDSS systematically sampled 4% of all patients from 1979 through 1995, and since 1996 has sampled 2% of the patients. The adjusted and reduced sample size was based on increased number of patients (more than doubled) assuming no major changes in the prevalence of different etiologic agents of diarrhea. A trained research assistant interviewed either the patient or the caregiver of young children. We extracted the relevant information on patients enrolled in the DDSS between 1993 and 2011.

2.2. Definition of Obesity

Overweight and obesity were defined following WHO guidelines for all age categories [15,16]. Patients were stratified into three age categories: 1) children under 5 years of age, 2) individuals aged 5 - 19 years, and 3) individuals older than 19 years. For children under 5, overweight and obesity was defined using weight-for-age z-score ($\geq+2.00$ SD). For individuals aged 5 to 19 years, overweight and obesity was defined using BMI-for-age z-score ($>+1.00$ SD). For those older than 19 years, overweight and obesity was defined as a BMI of greater than 25 kg/m^2. Normal weight and underweight were defined as follows: less and 5 years [weight-for-age z-score (≥-2.00 to $<+1.00$ SD; <-2.00 SD)], 5 - 19 years [BMI-for-age z-score (≥-2.00 to $+ 1.00$ SD; <-2.00 SD)] and above 19 years [BMI (18.5 to <25 kg/m^2; <18.5 kg/m^2)], respectively.

2.3. Sampling Frame

In total, 49,532 patients were enrolled in the DDSS during the study period (1993-2011). Of these, 26,623 were children less than 5 years old, 6859 were individuals aged 5 - 19 years and 16,050 were individuals older than 19 years. Among these three populations, overweight and obesity together represented 2% (n = 508), 1% (n = 96) and 8% (n = 1330) of the total population, respectively. The distribution of normal weight among the populations was 51% (n = 13,455), 65% (n = 4426) and 53% (n = 8,497) for children under 5, children 5 to 19, and individuals older than 19 years, respectively. The distribution of underweight among the population was 47% (n = 12,660), 34% (n = 2337) and 39% (n = 6223) among the respective age categories.

2.4. Data Analysis

All data were analysed using Statistical Package for Social Sciences (SPSS) Windows (Version 15.2; Chicago, IL) and Epi Info (Version 6.0, USD, Stone Mountain, GA). Differences in proportions were assessed using Chi-square tests, with a probability of <0.05 considered as statistically significant. Strength of association was determined using odds ratios (OR) with 95% confidence interval (CI). We computed Chi-square tests to test statistical significance in changing trends, assuming that the sample was random, each observation was classified into one cell only, and sample size was sufficiently large with adequate cell counts of 5 or greater in all cells. Finally, separate multinomial logistic regression analyses were performed for each age stratum. In the analysis, nutritional status (overweight or obese and underweight) was considered as the dependent variable, using normal weight as the reference variable. Socio-demographic factors were included in the regression analysis to identify variables independently associated with overweight and obesity. In the analysis, only those variables which were identified to be independently associated in univariate analyses were included in multinomial models.

2.5. Ethical Statement

The Diarrheal Disease Surveillance System (DDSS) of icddr,b is a routine ongoing activity of the Dhaka Hospital which has been approved by the Research Review Committee (RRC) and Ethical Review Committee (ERC) of icddr,b. At the time of enrollment, verbal consent was taken from the patients or the caregivers or guardians on behalf of the patients. The information was stored in the hospital database and used for conducting research. The DDSS of icddr,b is a scheduled activity on the hospital patients, and previously was performed after taking verbal consent from the parents or guardians of the patients following the hospital policy. Parents or guardians were assured about the non-disclosure of information collected from them, and were also informed about the use of data for analysis and using the results for improving patient care activities as well as publication without disclosing the name or identity of their children. ERC was satisfied with the voluntary participation, maintenance of the rights of the participants and confidential handling of personal information by the hospital physicians and has approved this consent procedure.

3. Results

From 1993 to 2011, the proportion of overweight and obese children under five years of age increased from 0.64% to 5.15% (chi-square for trend p < 0.001) (**Figure 1**). Among patients aged 5 to 19, the proportion of overweight and obese increased from 0.80% to 6.70% (chi-square for trend p < 0.001), and from 3.66% to 16.94% among those older than 19 years (chi-square for trend p < 0.001) during the study period (**Figure 1**). Between these periods, a sharp increasing trend was observed after 2006 among individuals from all age groups.

Among under-5 children and 5 to 19 years group, males were more likely to be overweight and obese compared to females; however, among those more than 19 years of age, females were more overweight and obese then males (**Figure 2**).

There was also a significant change in the proportion of normal weight individuals across all age strata. Mean weight-for-age score among under-5 children was -1.086 in 1993, and increased to -0.790 in 2011 (p < 0.001, 95% CI: -0.43, -0.30). For the 5 - 19 years age group change in BMI for z-score increased from -1.077 to -0.742 (p < 0.001, 95% CI: -0.46, -0.21) and for individuals aged above 19 years, there was an increase in BMI from 20.665 to 21.314 (p < 0.001, 95% CI: -0.85, -0.45) over the period (**Figure 3**).

Only 1% of overweight and obese under-five children were slum dwellers, and about 65% of them were males. There were significantly higher proportions of overweight and obese among under-5 children from families with better socioeconomic status, those with smaller family size, and those with high maternal literacy. Those who used sanitary toilet facilities and boiled water for drinking were also more likely to be overweight and obese, compared to those with well-nourished and malnourished children of this age group (see **Table 1**). In multinomial logistic regression among children less than five years of age, males, those with better socioeconomic status with high monthly income, living in the non-slum urban residential area, with high maternal literacy rate, who use sanitary toilet and who boiled drinking water were at greater risk of becoming overweight and obese compared to well-nourished and malnourished children (**Table 1**). Over the study period, it was observed that the proportion of overweight and obese individuals that presented in the hospital with high socioeconomic status increased from 15% to 27% (chi-square for trend p < 0.001) among under-5 children. Similarly, an increased trend was also found for individuals aged 5 - 19 years [15% to 40%; (chi-square for trend p < 0.001) and those more than 19 years age group [14% to 24% (chi-square for trend p < 0.001)] respectively (data not presented).

Univariate analyses indicated that all the explanatory variables that were found to be significantly associated with overweight and obesity among children less than 5 years old were also significantly associated with overweight and obesity for individuals aged 5 - 19 years, (**Table 2**). However, most of these dropped out when entered into the multinomial model, with the exception of those with smaller family size and those who used boiled water for drinking were at higher risk for the overweight and obesity (**Table 2**).

Similar findings were also observed for individuals aged 19 years and above, with the only exception being that males were 44% less likely to be overweight and obese than females (**Table 3**).

4. Discussion

Like many other developing countries, the prevalence of overweight and obesity among the general population is increasing in Bangladesh. From a database with systematic sampling of the Diarrheal Diseases Surveillance System (DDSS) of the Dhaka Hospital of icddr,b, this study found a gradual increase in the proportion of patients with overweight and obesity over the last two decades.

Obesity and overweight results from an imbalance between calories consumed and calories expended. Increased intake of energy-dense foods, and reduced physical activities due to sedentary work, changing modes of transportation, such as stress, lack of sleep and urbanization are among the frequently cited risk factors for overweight and obesity. Children are increasingly exposed to high-fat, high-sugar, high-salt, energy-dense, and micro-nutrient-poor foods [17,18]. These dietary patterns and
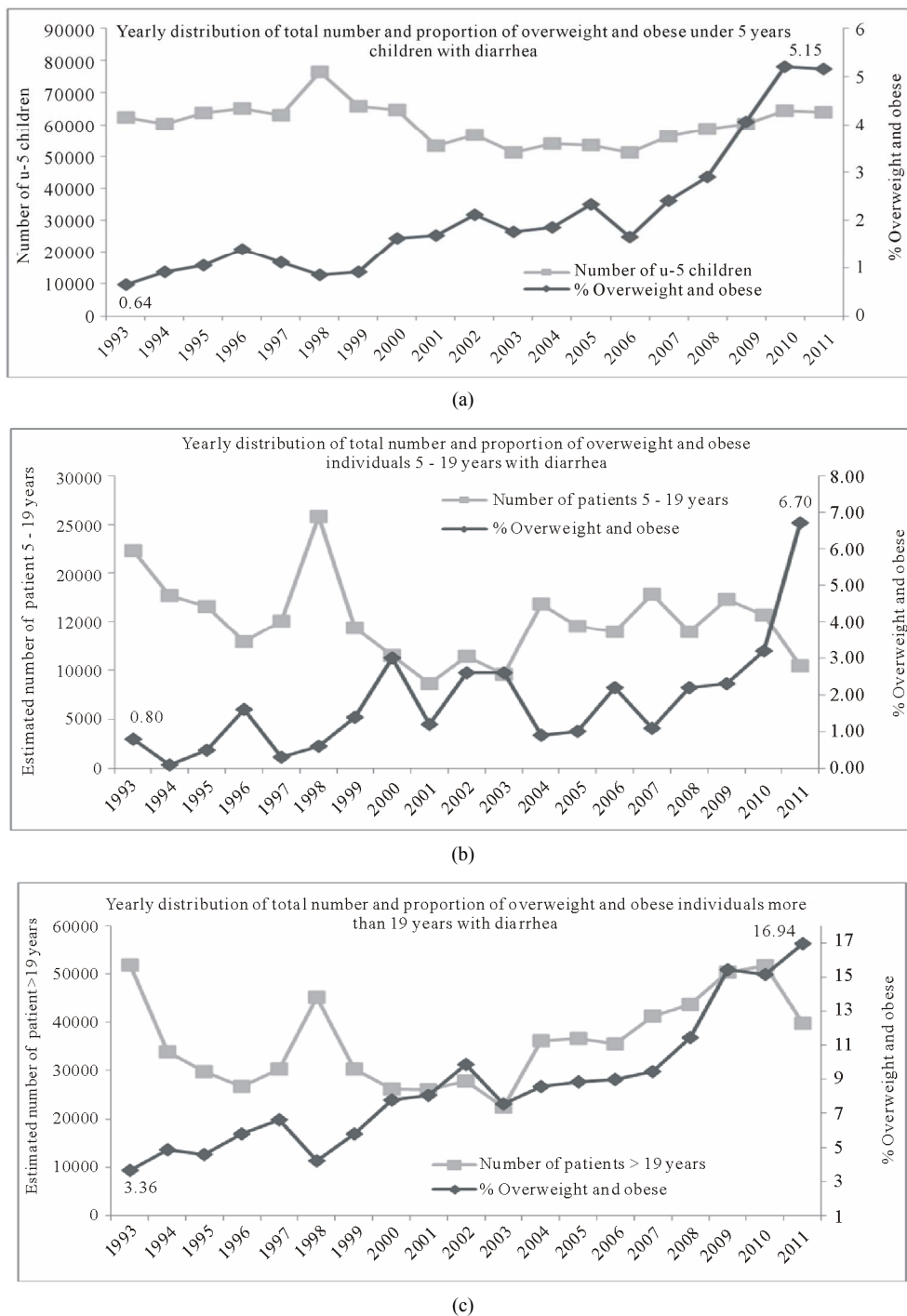
(a)

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Figure 1. Yearly distribution of total number and proportion of overweight and obese patients with diarrhea who attended Dhaka Hospital (1993-2011).

low levels of physical activity or increased sedentary behavior can result in sharp increases in childhood obesity as well as obesity among the general population [19].

We have noted that male sex, higher socioeconomic status, and living in non-slum areas are independently associated with overweight and obesity both in the univariate and in the multivariate analysis [20,21]. However,

in different settings females have been reported to be at higher risk for obesity [22-24]. With an estimated current population of 12 million [25], Dhaka ranks 11th largest city in the world, and it is expected to be the home of 25 million people by 2025 [26]. This rapid urbanization has been associated with reduced open spaces. Environmental pollution [27,28], climate change [29,30] and increasing
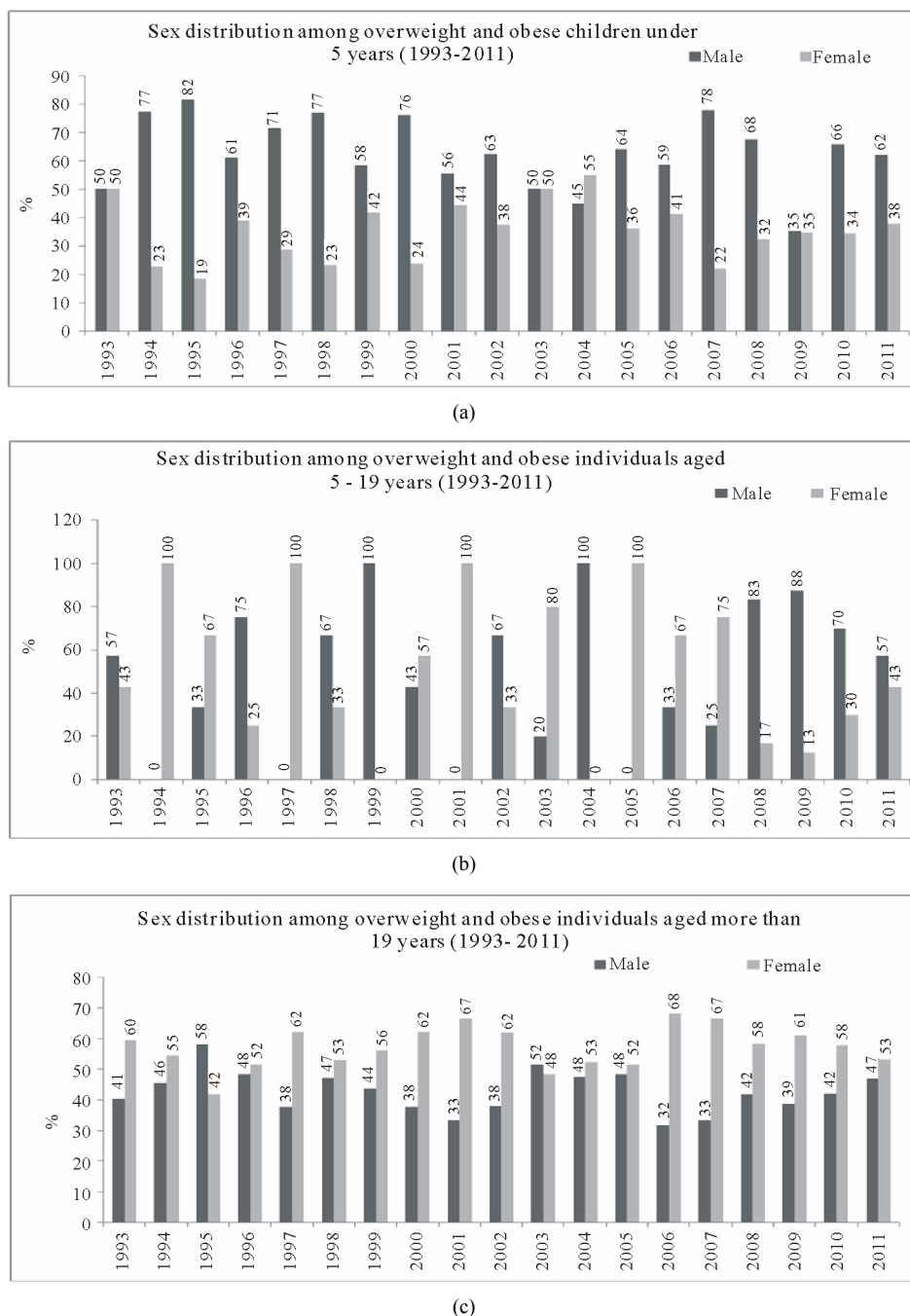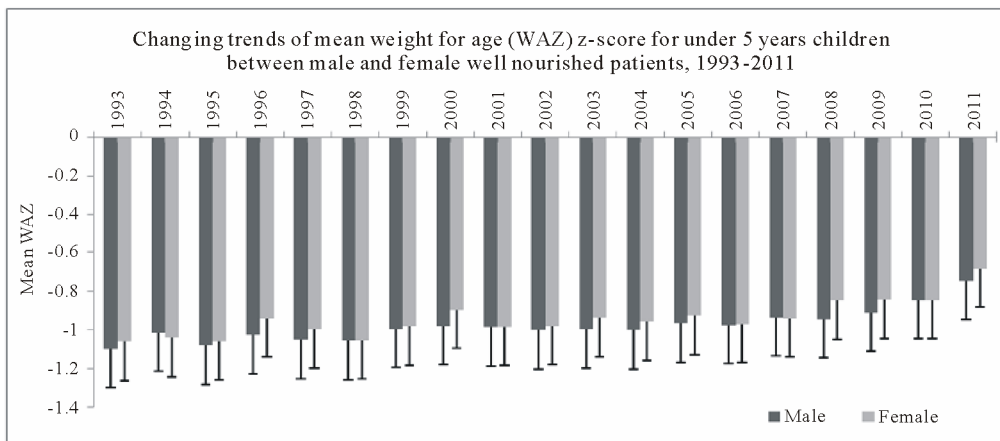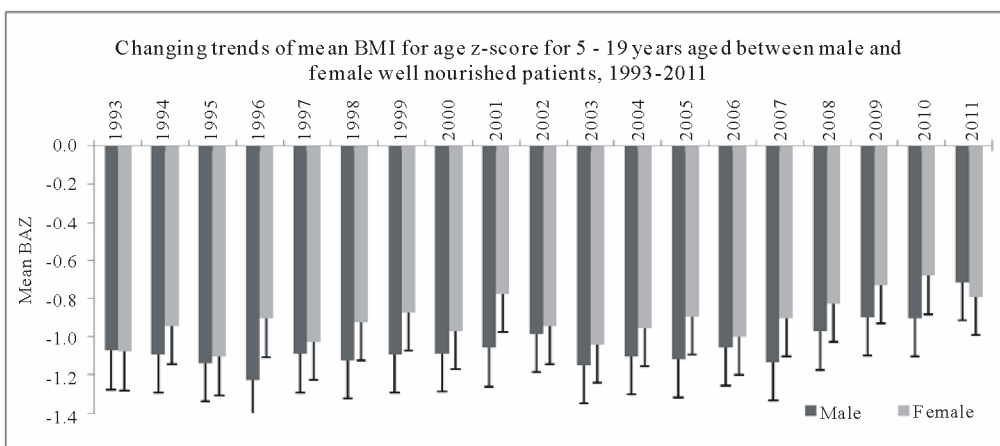
(a)

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Figure 2. Yearly sex distribution among overweight and obese individuals in three different age categories who attended Dhaka Hospital (1993-2011).

access to day-to-day modern amenities may also contribute to promoting sedentary lifestyles. Additionally, changes in dietary habits especially of children and young adults towards non-traditional foods with higher amounts of fats [31,32] may also be contributing to the increase in overweight and obesity. The present study found that males less than 19 years were more likely to be overweight and obese which has also been reported in other studies [33]. It is perhaps not a surprising that males aged more than 19 years had a 44% lower risk of being overweight and obese. Some potential explanations for these sex differences include physiological differences between males and females, use of contraceptive pills among this age group [34], and decreased outdoor physical activity levels due to increased household responsibilities among females. However, males are the main earning source of the household earning, which often means they are engaged with hard labor.

(a)

(b)

(c)

Figure 3. Yearly change of mean nutritional status among well-nourished individuals in three different age categories who attended Dhaka Hospital (1993-2011).

In the present study, the only factors significantly associated with overweight and obesity in the multinomial regression analysis were high monthly income and practice of drinking boiled water among the 5 - 19 year age group, despite significant differences in the univariate analysis. Use of boiled drinking water and sanitary toilet were the proxy indicators of better socioeconomic status, and may also serve as a proxy measure for both increased access to food and consumption of more energy-dense foods.

Table 1. Socio-demographic characteristics and their association with overweight/obese and malnourished status among under-5 children.

Socio-demographic characteristics	Overweight and obese n = 508 (%)	Well nourished n = 13,455 (%)	Malnourished n = 12,660 (%)	p value	Overweight and obese		Malnourished	
					Unadjusted OR (95% CI) p value	Adjusted OR (95% CI) p value	Unadjusted OR (95% CI) p value	Adjusted OR (95% CI) p value
Age				<0.001				
24 - 59 months	45 (1)	1657 (37)	2784 (62)		0.72 (0.53, 1.00) 0.046	0.82 (0.59, 1.23) 0.214	2.12 (1.97, 2.26) <0.001	1.83 (1.70, 1.97) <0.001
12 - 23 months	159 (2)	3691 (51)	3408 (47)		1.15 (0.95, 1.40) 0.165	1.17 (0.95, 1.42) 0.133	1.16 (1.09, 1.23) <0.001	1.26 (1.06, 1.20) <0.001
0 - 11 months	304 (2)	8107 (54)	6468 (44)		1.00	1.00	1.00	1.00
Sex				<0.001				
Male	331 (65)	8082 (60)	8000 (63)		1.24 (1.03, 1.49) 0.022	1.31 (1.08, 1.57) 0.006	1.14 (1.08, 1.20) <0.001	1.14 (1.07, 1.20) <0.001
Female	177 (35)	5373 (40)	4660 (37)		1.00	1.00	1.00	1.00
Maternal literacy				<0.001				
Literate	487 (96)	9794 (73)	5774 (46)		8.67 (5.69, 13.44) <0.001	3.66 (2.31, 5.79) <0.001	0.31 (0.29, 0.33) <0.001	0.60 (0.56, 0.64) <0.001
Illiterate	21 (4)	3660 (27)	6889 (54)		1.00	1.00	1.00	1.00
Family size				<0.001				
>mean; (5)	213 (42)	5058 (38)	4330 (34)		0.83 (0.69, 0.99) 0.048	1.13 (0.93, 1.36) 0.219	1.16 (1.10, 1.220 <0.001	0.90 (0.85, 0.96) <0.001
≤mean; (5)	295 (58)	8397 (62)	8330 (66)		1.00	1.00	1.00	1.00
Residence				<0.001				
Non-slum urban	504 (99)	12662 (94)	10676 (84)		7.89 (2.94, 21.16) <0.001	2.01 (0.74, 5.51) 0.174	0.33 (0.31, 0.37) <0.001	0.73 (0.67, 0.81) <0.001
Slum urban	4 (1)	793 (6)	1984 (16)		1.00	1.00	1.00	1.00
Monthly income				<0.001				
>73 US$	388 (76)	623 (42)	2184 (17)		8.96 (6.01, 13.35) <0.001	3.76 (2.41, 5.86) <0.001	0.20 (0.19, 0.22) <0.001	0.42 (0.39, 0.46) <0.001
37-≤73 US$	94 (19)	4457 (33)	4056 (32)		2.74 (1.77, 4.24) <0.001	1.59 (1.06, 2.52) 0.047	0.48 (0.45, 0.51) <0.001	0.72 (0.68, 0.78) <0.001
≤37 US$	26 (5)	3375 (25)	6411 (51)		1.00	1.00	1.00	1.00
Wealth quintile				<0.001				
High income	204 (61)	3756 (28)	1243 (10)		10.83 (6.06, 19.34) <0.001	1.99 (1.02, 3.82) 0.044	0.15 (0.13, 0.16) <0.001	0.35 (0.31, 0.40) <0.001
Upper middle	94 (19)	3375 (25)	2144 (17)		3.73 (2.04, 6.82) <0.001	0.93 (0.48, 1.81) 0.837	0.28 (0.26, 0.30) <0.001	0.55 (0.40, 0.61) <0.001
Middle income	66 (13)	2459 (19)	2292 (18)		3.59 (1.94, 6.67) <0.001	1.22 (0.63, 2.34) 0.559	0.41 (0.38, 0.447) <0.001	0.66 (0.60, 0.73) <0.001
Lower middle	23 (5)	2067 (16)	3232 (26)		1.68 (0.85, 3.35) 0.137	0.96 (0.48, 1.93) 0.905	0.69 (0.64, 0.75) <0.001	0.86 (0.79, 0.94) 0.001
Low income	12 (2)	1606 (12)	3636 (29)		1.00	1.00	1.00	1.00
Sanitary toilet				<0.001				
Sanitary	444 (87)	8854 (66)	6116 (48)		3.61 (2.77, 4.70) <0.001	1.47 (1.07, 2.01) 0.016	0.49 (0.46, 0.51) <0.001	1.14 (1.07, 1.22) <0.001
Non-sanitary	64 (13)	4601 (34)	6544 (52)		1.00	1.00	1.00	1.00
Drink boiled water				<0.001				
Yes	266 (52)	4502 (34)	2254 (18)		2.19 (1.83, 2.61) <0.001	0.95 (0.77, 1.17) 0.626	0.43 (0.41, 0.46) <0.001	0.99 (0.92, 1.06) 0.777
No	242 (48)	8953 (64)	10406 (82)		1.00	1.00	1.00	1.00

N.B: Well-nourished considered as reference category.

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Table 2. Socio-demographic characteristics and their association with overweight/obese and malnourished status among individuals aged 5 - 19 years.

Socio-demographic characteristics	Overweight and obese n = 97 (%)	Well nourished n = 4425 (%)	Malnourished n = 2337 (%)	p value	Overweight and obese		Malnourished	
					Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Sex				<0.001				
Male	55 (57)	2340 (53)	1584 (68)		1.67 (0.78, 1.75) 0.456	1.33 (0.86, 2.05) 0.196	1.87 (1.69, 2.08) <0.001	1.83 (1.64, 2.05) <0.001
Female	42 (43)	2085 (47)	753 (32)		1.00	1.00	1.00	1.00
Education				<0.001				
Maternal/self literate	54 (56)	2145 (49)	926 (40)		1.33 (0.89, 2.00) 0.163	0.78 (0.47, 1.28) 0.330	0.69 (0.63, 0.77) <0.001	0.86 (0.76, 0.97) 0.017
Illiterate	43 (44)	2279 (52)	1411 (60)		1.00	1.00	1.00	1.00
Family size (> mean; 5)				<0.001				
> mean; (5)	33 (34)	2020 (45)	1060 (45)		1.63 (1.07, 2.49) 0.024	0.72 (0.60, 0.86) <0.001	1.01 (0.92, 1.12) 0.818	1.05 (0.93, 1.17) 0.412
≤mean; (5)	64 (66)	2405 (54)	1277 (34)		1.00	1.00	1.00	1.00
Residence				<0.001				
Non-slum urban	90 (93)	3836 (87)	1902 (81)		0.51 (0.23, 1.10) 0.085	0.89 (0.38, 2.09) 0.785	1.49 (1.30, 1.71) <0.001	1.14 (0.97, 1.32) 0.104
Slum urban	7 (7)	589 (13)	435 (19)		1.00	1.00	1.00	1.00
Monthly income				<0.001				
>73 US$	47 (48)	1017 (23)	354 (15)		4.27 (2.54, 7.19) <0.001	3.27 (1.60, 6.61) 0.001	0.53 (0.46, 0.61) <0.001	0.72 (0.63, 0.86) <0.001
37-≤73 US$	29 (30)	1465 (33)	710 (30)		1.83 (1.04, 3.22) 0.036	1.94 (1.01, 3.74) 0.046	0.74 (0.66, 0.83) <0.001	0.86 (0.75, 0.98) 0.026
≤37 US$	21 (22)	1942 (44)	1273 (55)		1.00	1.00	1.00	1.00
Wealth quintile				<0.001				
Rich	45 (51)	692 (24)	366 (17)		3.26 (1.63, 6.51) 0.001	1.07 (0.42, 2.83) 0.896	0.51 (0.43, 0.60) <0.001	0.78 (0.62, 0.98) 0.034
Upper middle	17 (19)	932 (23)	368 (17)		1.27 (0.58, 2.79) 0.550	0.63 (0.25, 1.63) 0.334	0.53 (0.45, 0.62) <0.001	0.65 (0.53, 0.79) <0.001
Middle	3 (3)	512 (13)	250 (12)		0.41 (0.11, 1.49) 0.175	0.26 (0.07, 1.01) 0.051	0.65 (0.54, 0.79) <0.001	0.74 (0.60, 0.91) 0.004
Lower middle	13 (15)	886 (22)	612 (29)		1.02 (0.45, 2.35) 0.958	0.81 (0.34, 1.89) 0.623	0.92 (0.79, 1.08) 0.313	0.99 (0.85, 1.16) 0.970
Poor	10 (11)	697 (18)	521 (25)		1.00	1.00	1.00	1.00
Sanitary toilet				<0.001				
Sanitary	69 (71)	2500 (57)	1112 (48)		1.90 (1.22, 2.96) 0.005	1.19 (0.64, 2.20) 0.586	0.70 (0.63, 0.77) <0.001	0.94 (0.83, 1.08) 0.400
Non-sanitary	28 (29)	1925 (43)	1225 (52)		1.00	1.00	1.00	1.00
Drink boiled water				<0.001				
Yes	42 (43)	835 (19)	299 (13)		3.28 (2.18, 4.94) <0.001	1.97 (1.78, 3.28) 0.010	0.63 (0.55, 0.73) <0.001	0.87 (0.74, 1.04) 0.137
No	55 (57)	3590 (81)	2038 (87)		1.00	1.00	1.00	1.00

N.B: Well-nourished considered as reference category.

Table 3. Socio-demographic characteristics and their association with overweight/obese and malnourished status among individuals aged more than 19 years.

Socio-demographic characteristics	Overweight and obese n = 1324 (%)	Well nourished n = 8467 (%)	Malnourished n = 6216 (%)	p value	Overweight and obese		Malnourished	
					Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Sex				<0.001				
Male	572 (43)	4852 (57)	3610 (58)		0.50 (0.49, 0.62) <0.001	0.56 (0.49, 0.65) <0.001	1.03 (0.96, 1.10) 0.395	1.10 (1.01, 1.19) 0.022
Female	752 (57)	3615 (43)	2606 (42)		1.00	1.00	1.00	1.00
Self literacy				<0.001				
Literate	820 (70)	4660 (57)	2548 (42)		1.78 (1.56, 2.04) <0.001	1.12 (0.95, 1.29) 0.182	0.53 (0.49, 0.57) <0.001	0.76 (0.71, 0.83) <0.001
Illiterate	344 (30)	3486 (43)	3584 (58)		1.00	1.00	1.00	1.00
Residence				<0.001				
Non-slum urban	1287 (97)	7704 (91)	5172 (83)		3.15 (2.25, 4.41) <0.001	1.25 (0.87, 1.81) 0.226	0.50 (0.46, 0.56) <0.001	0.85 (0.76, 0.95) 0.006
Sum urban	37 (3)	763 (9)	1044 (17)		1.00	1.00	1.00	1.00
Monthly income >100 US$				<0.001				
>73 US$	799 (68)	3121 (38)	1220 (20)		5.58 (4.63, 6.78) <0.001	2.47 (1.99, 3.07) <0.001	0.31 (0.28, 0.34) <0.001	0.52 (0.47, 0.58) <0.001
37-≤73 US$	231 (20)	2189 (27)	1563 (25)		2.29 (1.87, 2.81) <0.001	1.43 (1.15, 1.78) 0.001	0.57 (0.53, 0.62) <0.001	0.76 (0.69, 0.82) <0.001
≤37 US$	144 (12)	2882 (35)	3393 (55)		1.00	1.00	1.00	1.00
Wealth quintile				<0.001				
Rich	608 (52)	1861 (23)	621 (10)		10.21 (7.20, 14.47) <0.001	4.71 (3.12, 7.10) <0.001	0.22 (0.20, 0.25) <0.001	0.43 (0.37, 0.51) <0.001
Upper middle	297 (26)	1896 (24)	941 (16)		4.90 (3.42, 7.01) <0.001	2.89 (1.94, 4.31) <0.001	0.33 (0.29, 0.37) <0.001	0.51 (0.45, 0.58) <0.001
Middle	146 (13)	1675 (21)	1262 (21)		2.73 (1.87, 3.97) <0.001	1.98 (1.32, 2.96) 0.001	0.50 (0.45, 0.55) <0.001	0.66 (0.59, 0.75) <0.001
Lower middle	80 (7)	1488 (19)	1496 (25)		1.68 (1.12, 2.52) 0.012	1.33 (0.88, 2.02) 0.176	0.66 (0.60, 0.74) <0.001	0.78 (0.70, 0.87) <0.001
Poor	35 (3)	1094 (13)	1658 (28)		1.00	1.00	1.00	1.00
Sanitary toilet				<0.001				
Sanitary	1114 (84)	5524 (65)	3102 (50)		2.61 (2.23, 3.06) <0.001	1.16 (0.96, 1.40) 0.115	0.55 (0.51, 0.59) <0..001	0.96 (0.89, 1.04) 0.311
Non-sanitary	210 (16)	2943 (35)	3114 (50)		1.00	1.00	1.00	1.00
Drink boiled water				<0.001				
Yes	590 (45)	2108 (25)	833 (13)		2.32 (2.05, 2.64) <0.001	1.02 (0.88, 1.18) 0.831	0.49 (0.45, 0.53) <0.001	0.95 (0.85, 1.05) 0.336
No	722 (55)	6359 (75)	5383 (87)		1.00	1.00	1.00	1.00
Smoking				<0.001				
Yes	136 (12)	1760 (22)	1620 (26)		0.48 (0.40, 0.58) <0.001	0.72 (0.58, 0.88) 0.002	1.29 (1.02, 1.40) <0.001	1.16 (1.06, 1.27) 0.001
No	1038 (88)	6432 (78)	4556 (74)		1.00	1.00	1.00	1.00

N.B: Well-nourished considered as reference category.

FNS

The other alarming observation was an increasing trend of nutritional status (mean weight-for-age z-score, BMI-for-z score and BMI) among the normal weight individuals irrespective of age and sex. The Dhaka Hospital is the largest diarrheal disease hospital in Bangladesh, and receives patients from the urban and peri-urban area of Dhaka. Increased proportion of overweight and obese individuals over the two decades (1993 to 2011) and increased average BMI among well-nourished individuals makes an iceberg impression about early signs of the increasing burden of overweight and obesity among the general population. Bangladesh is a country in transition and the national GDP per capita of Bangladesh is gradually increasing [35]. This gross economic improvement may have an impact on the overall behavioral change in general population, which has also been supported by our present study as evidenced by an increase in the number of individuals with higher economic status.

The prevalence of overweight and obesity is gradually increasing in all age groups, and establishment of effective preventive measures requires an understanding and appreciation of the magnitude of the problems and its consequences by health planners and policymakers. The findings from the present study were comparable with the global as well as Asian context [36]. An emphasis on education campaigns among general population, with several national programmes like "Fit and Trim" urgently need to be introduced [37] to increase awareness of the adverse effects and consequences of overweight and obesity. At the same time, national guidelines are needed to mitigate the problem of overweight and obesity in children and adolescents [38]. The size of open spaces is rapidly reducing in this increasingly populated city. The built environment can have a significant impact on physical activity behaviours, and in planning for the expansion of the city, provisions for open spaces for physical exercise of the residents should seriously be taken into consideration.

5. Limitations

This study was conducted among people attending a large diarrheal disease health facility, and may not be representative of the general population. However, the hospital provides cost-free treatment and it is accessible by all people, irrespective of their socioeconomic or other status. Strengths of the study include measured height and weight, using a large, systematic sample and unbiased sampling of the surveillance system.

6. Conclusion

Overweight and obesity are growing public health concerns in Bangladesh. In our present analyses, we noted a significant increase in the proportion of overweight and obese patients presenting at the urban diarrheal disease hospital over the last two decades. These changes may be in part due to improved socio-economic conditions, differences in food behaviours and other lifestyle factors. Further studies are needed to understand the national burden of obesity and overweight. Studies examining the nutrition, physical activity and lifestyle behaviours of obese and overweight individuals may help to elucidate individual characteristics associated with the increased prevalence of overweight in Bangladesh. Additionally, examining the host characteristics that would predict susceptibility of the overweight and obese population to diarrheal illnesses and other acute diseases common in Bangladesh may be of interest.

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