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INTERNATIONAL JOURNAL OF CURRENT RESEARCH

International Journal of Current Research
Vol.10, pp.074-083, November, 2010

ISSN: 0975-833X

RESEARCH ARTICLE

PREVALENCE OF OVERWEIGHT AND OBESITY AMONG BENGALEE ADOLESCENTS IN MIDNAPORE TOWN, WEST BENGAL, INDIA

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ARTICLE INFO

Article History:
Received 12th September, 2010
Received in revised form
14th October, 2010
Accepted 27th October, 2010
Published online 1st November, 2010

Key words:

Adolescent,
Bengalee,
Obesity,
Nutrition,
Socio-economic status.

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ABSTRACT

Objective

Obesity has become known as an epidemic worldwide. Therefore a study was undertaken to assess the prevalence of adolescent overweight and obesity in Midnapore town, West Bengal, India. The results were compared with national and international prevalence levels in respect to economic status.

Methods

The subjects were selected from Bengalee speaking lower-middle socio-economic class. A total of 1265 (640 boys and 625 girls) children aged 10-12 years were measured and included in the present analysis. Body mass index (BMI) was computed using the following standard equation: BMI = Weight (kg)/height $(m)^2$. Presence of overweight and obesity were evaluated using the International cut-off values as recommended by International Obesity Task Force (IOTF).

Results

The overall frequencies of overweight and obesity were 5.69% and 0.79%, respectively. The prevalence of overweight was significantly higher among girls (7.20%) compared to boys (4.22%). They had 1.89 (95% CI: 1.33 – 3.18) fold more chances to being overweight than the boys. There was a significant decreasing trend in the rate of overweight with increasing age among boys. The odds ratios for ages 10 and 11 were 3.94 and 3.01, respectively. The highest rate was observed among 10 year in both boys (5.88%) and girls (7.88%), while the lowest rate was found among 12 years in both boys (1.46%) and girls (6.37%). The prevalence of obesity was slightly higher in girls than in boys across ages.

Conclusions

The moderate rates of overweight and low rate of obesity were found among adolescents of Midnapore Town, West Bengal. We recommend that similar studies be undertaken among children and adolescents of different socioeconomic groups of different ethnicities from diverse parts of India. Such studies would help us to have a better and clearer picture on the overweight and obesity situation in India and other developing countries experience with rapid economic transition.

INTRODUCTION

Obesity has become known as an epidemic worldwide (Kaur *et al.,* 2008). Childhood obesity was considered a problem of affluent countries. However today, the problem has started appearing even in developing countries. Globally, the prevalence of childhood obesity varies from about 30% - 2% in USA and sub-Saharan Africa, respectively. Currently the prevalence of obese school children is 20% in UK and Australia, 15.8% in Saudi Arabia, 15.6% in Thailand, 10% in Japan and 7.8% in Iran (Al-Nuaim *et al.,* 1996; Mo-Suwan et al 1993). It is well documented that the prevalence rate has largely increased over the last two decade in both developed and developing countries (Doll et al 2002). Obesity is associated with several chronic diseases and mortality. Socioeconomic differences act as a risk factor through which differences contribute to morbidity and mortality (Martikainen and Marmot, 1999). The existence of health differences among different socioeconomic classes in India has already been reported. The prevalence of overweight and obesity (BMI $\geq$ 25.0 kg/m^2) among adult women in India has rapidly increased from 12.8 % in 1998-99 to 14.8% in 2005-06 (IIPS, 2000; 2007).

High and middle-income countries are facing rapid increases in overweight and obesity among children and adolescents. In England, obesity in children and adolescents of all ethnicities has increased nearly two-fold over the past 10 years (Matijasevich *et al.,* 2009). In Brazil, the prevalence of obesity in older children and adolescents (aged 6-18 years) almost tripled between 1975 and 1997, and is still rising (Wang *et al.,* 2002).

In general, information on trends in overweight and obesity prevalence in low-income countries like India are lacking due to absence of systematic studies. Hitherto, national representative data for childhood obesity in India is unavailable. Nevertheless, published studies from Chennai and Delhi have shown that prevalence of obesity were about 6% and 7%, respectively (Subramanyam *et al.,* 2003; Kapil *et al.,* 2002). However, no data is available in respect to the prevalence of overweight and obesity among adolescents of Midnapore town, West Bengal, India. In view of this, the present investigation was undertaken to report the level of overweight and obesity among Bengalee adolescents in Midnapore town. Moreover, these results were compared with national and international prevalence levels in respect to economic classification of country (World Bank, 2009).

MATERIALS AND METHODS

A cross-sectional study was undertaken during November, 2008 – March, 2009 in Midnapore town of West Bengal, India. The city lies just north of the Kasai River, near about 130 km way from Kolkata, the provincial capital of West Bengal. Midnapore is located at 22.25°N, 87.65° E and is 23 metres above sea level. Total area of the town is 18.36 sq. km. According to latest census, the city had a population of 153,349. Midnapore has an average literacy rate of 75%, higher than the national average of 59.5%. The male and female literacy rates are 80%, and 71%, respectively. The study subjects were selected randomly from Bengalee speaking lower-middle socio-economic class following house to house visit. The socioeconomic status of the subjects was screened based on the social classification as described by recent Indian study (Agarwal, 2008). This study included only healthy children (without any physical deformities) following screening. Parents were informed about the objectives of the study and their consent was obtained. Information on age, sex, weight and height were recorded with the help of questionnaire. Unfortunately, no information about maturation status of teenagers was obtained. Children's age was recorded as reported by mothers and verified further with other senior members of the household. The sample size was calculated using standard formula ($n= 4pq/d^2$) found elsewhere (Cochran, 1963). Based on this formula (prevalence of overweight and obesity 14%, d= 2% and q = 1 – p) the estimated sample size is 1204 for both sexes. Additional 5% (n=1204 + 61= 1265) was added to make the sample more representative and compensate for the design effect. A total of 1265 (640 boys and 625 girls)

children aged 10-12 years were measured and included in the present analysis. Ethical approval was obtained from the Vidyasagar University ethics committee.

The height and weight measurements were made and recorded following the standard techniques as described by Lohman *et al.* (1988). Height and weight was measured using anthropometer rod and weighing scale to the nearest of 0.1cm and 0.5kg, respectively. The weighing scales were calibrated daily against standard weight. Technical errors of measurements (TEM) were computed and they were found to be within acceptable limits (Ulijaszek and Kerr 1999). BMI was computed using the following standard equation: BMI = Weight in kg / height squared in meter. Presence of overweight and obesity were evaluated using the cut-off values of international survey as suggested by Cole *et al.* (2000) and recommended by International Obesity Task Force (IOTF).

The distributions of the height, weight were not significantly skewed. Student's t-tests and one-way analysis of variance were performed to test for differences in mean anthropometric characteristics by sex and age of children. Odds ratio (OR) was calculated using simple equation: [OR = (A/C) / (B/D)] (Streiner, 1998) to measure the risk for being overweight and obesity by age and sex. All statistical analyses were undertaken using the SPSS Statistical Package. Statistical significance was considered as $p < 0.05$.

RESULTS

The mean and standard deviation of height, weight and BMI by age and sex of the studied subjects are presented in Table 1. In general, girls were taller and heavier at all ages compared to boys. Results revealed that there was a significant increasing trend in height, weight and BMI with age except BMI among boys. In most cases, there existed significant sex differences in height, weight and BMI. Table 2 presents the prevalence of overweight and obesity among the subjects. The overall prevalence of overweight and obesity were 5.69% and 0.79%, respectively. Moreover, the prevalence of overweight was significantly (chi-square = 4.69, $p<0.05$) higher among girls (7.20%) compared to boys (4.22%). Girls had a 1.89 fold (95% CI: 1.33 – 3.18) more chance to being overweight than boys. There was a significant decreasing trend in the rate of overweight with increasing age among boys (chi-square for linear trend = 5.082; p = 0.02418). The odds ratios (age 12 was set as reference) for ages 10 and 11 were 3.94 and 3.01, respectively. The highest rate was observed among 10 year olds in both boys (5.88%) as well as girls (7.88%), while the lowest rate was found among 12 year olds in both boys (1.46%) and girls (6.37%). The prevalence of obesity was similar in both sexes across ages. The comparison of rates of overweight/obesity by age and sex was presented in Figure 1.

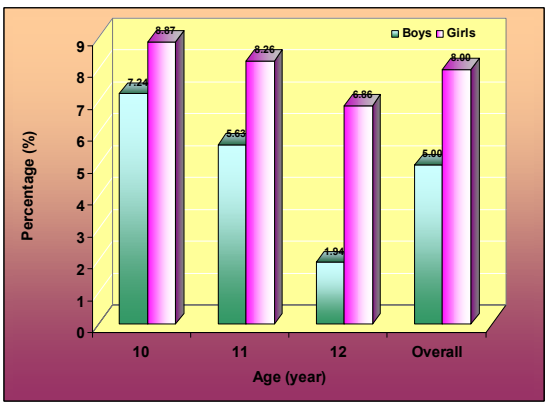

Fig.1. Comparison of rates of overweight/obesity by age and sex of the subjects

DISCUSSION

Developed and developing countries are facing rapid increases in overweight and obesity among children and adolescents. Overweight and obesity are now a global health problem so much so that a new word *"globesity"* has been coined which refers to the universal health burden of obesity (Mukhopadhyay *et al.,* 2005). The patterns of overweight/obesity differ by age, sex, rural or urban residence and socioeconomic position (SEP) and vary between and within countries (Matijasevich *et al.,* 2009). Overweight and obesity was influenced by several factors among which socio-economic status is an important one (Sobal

and Stunkard, 1989; Bose *et al.,* 2007a). It has been shown that the social patterning of overweight varies between and within populations over time (Matijasevich *et al.,* 2009). It has also been suggested that specific approaches should be developed within populations in order to contain the obesity epidemic and reduce disparities (Matijasevich *et al.,* 2009). However, although this health burden has been well documented in most developed and some developing countries, there is paucity of data from Indian, particularly among the Bengalee ethnic population of West Bengal (Sadhukhan *et al.,* 2007). Moreover, to the best of our knowledge, there is no data available on the prevalence of overweight and obesity among adolescents of Midnapore town of West Bengal, India.

In general, our study showed (Table 3) that the prevalence of overweight and obesity of Midnapore adolescents were similar to those reported among earlier Indian surveys among middle-income children and adolescents (Kaur *et al.,* 2008; Kuriyan *et al.,* 2007; Kaur and Kapil, 2008). All these studies used international cutoff point for assessment of overweight and obesity as recommended by Cole *et al.* (2000). The rates being reported in our study are lower than high income (Kaur *et al.,* 2008; Subramanyam *et al.,* 2003; Kapil et al 2002; Sadhukhan *et al.,* 2007; Sood et al 2007; Sharma *et al.,* 2007; Mehta *et al.,* 2007; Marwaha *et al.,* 2006; Bose *et al.,* 2007; Khadilkar and Khadilkar, 2004; Sidhu *et al.,* 2004; Kaneria *et al.,* 2006) but higher than low income (Kaur *et al.,* 2008; Kaur and Kapil, 2008; Marwaha

Table 1. Mean and standard deviation of height, weight and BMI by age and sex of the studied subjects

Age (years)	n		Boys		Girls		t-value
	Boys	Girls	Mean	SD	Mean	SD	
Height (cm):							
10	221	203	136.81	8.85	139.62	7.99	3.421*
11	213	218	140.92	8.21	142.47	6.99	2.112*
12	206	204	144.99	8.79	146.17	6.36	1.556
F-value			47.98**		57.04**		
Weight (kg):							
10	221	203	29.15	6.91	30.81	6.91	2.471*
11	213	218	31.50	6.69	34.17	7.05	4.009*
12	206	204	33.66	6.85	37.21	7.42	5.034*
F-value			23.33**		40.94**		
BMI (kg/m^2):							
10	221	203	15.42	2.50	15.88	2.38	1.937
11	213	218	15.75	2.35	16.73	2.71	4.007*
12	206	204	15.89	2.08	17.31	2.66	6.025*
F-value			2.28		15.68**		

* Significant sex differences; $p < 0.05$. ** Significant age variations; $p<0.05$.

Table 2. Prevalence of overweight and obesity by age and sex of the studied subjects

Age (Year)	n		Boys			Girls		
	Boys	Girls	Overweight**	Obesity	Total***	Overweight	Obesity	Total
10	221	203	5.88	1.36	7.24	7.88	0.98	8.87
11	213	218	5.16	0.47	5.63	7.34	0.91	8.26
12	206	204	1.46	0.49	1.94	6.37*	0.49	6.86
Total	**640**	**625**	**4.22***	**0.78**	**5.00***	**7.20***	**0.80**	**8.00***

* Significant sex differences; $p < 0.05$. **Chi-Square for linear trend = 5.082, $p<0.05$. *** Chi-Square for linear trend = 6.235, $p<0.05$. Overall: Overweight = 5.69%, Obesity= 0.79%, total = 6.48 %

et al., 2006; Kaneria *et al.,* 2006; Gupta *et al.,* 2006) children and adolescents as has been found in previous Indian studies. These results indicated that there was a clear association between socio-economic status and prevalence of overweight and obesity in India.

The prevalence of overweight and obesity by gender and country economic classification is presented in Table 4. In general, the prevalence of overweight and obesity by children and adolescents was highest in high income countries (e.g. Bahrain, Canada, etc.) (Magarey *et al.,* 2001; Al-Sendi *et al.,* 2003; Trembley *et al.,* 2002; Kautiainen *et al.,* 2002; Krasses *et al.,* 2001; Ko *et al.,* 2008; Vignolo *et al.,* 2004; Matsushita *et al.,* 2004; El-Hazmi and Warsy, 2002; Zimmermann *et al.,* 2004; Flegal *et al.,* 2001). These rates were high in upper-middle income countries (Cole *et al.,* 2000; del Rio-Navarro *et al.,* 2004; Stettler *et al.,* 2002; Oner *et al.,* 2004) followed by intermediate rates in lower-middle income countries including the ones being reported in the present study (Wang, 2001; Kelishadi *et al.,* 2007; Kruger *et al.,* 2006; Jinabhai *et al.,* 2007). The lowest rates were found in low income countries like Nigeria and Senegal (Ben-Bassey *et al.,* 2007; Benefice *et al.,* 2004).

Table 3. Prevalence of overweight and obesity (defined by IOTF) in Indian children and adolescents by income groups.

Place of work	Reference	Survey date	Age group (years)	Sex	Overweight (%)	Obesity (%)
High income:						
Bangalore	Sood et al., 2007	INA	9-18	Girls	15.14	2.62
Chennai	Subramanyam et a., 2003	1998	10-15	Girls	9.67	6.23
Delhi	Kapil et al., 2002	2001	10-16	Boys	23.10	8.30
				Girls	27.70	5.50
Delhi	Sharma et al., 2007	INA	4-17	Boys	23.96	7.75
				Girls	20.47	4.69
Delhi	Mahta et al., 2007	2002	16-17	Girls	15.20	5.30
Delhi	Marwaha et al., 2006	INA	5-18	Boys	16.75	5.59
				Girls	19.01	5.73
Delhi	Kaur et al., 2008	2006	5-18	Boys	13.40	12.2
				Girls	12.20	6.50
Kolkata	Bose et al., 2007b	2002	6-9	Girls	17.63	5.10
Pune	Khadilkar & Khadilkar 2004	INA	10-15	Boys	19.90	5.70
Amritsar	Sidhu et al., 2006	2002	6-11	Boys	12.24	5.92
				Girls	14.31	6.27
Udaipur	Kaneria et al., 2006	2002	12-17	Both	4.85	3.73
Middle income:						
Bangalore	Kuriyan et al., 2007	INA	6-16	Both	6.40	0.00
Delhi	Kaur & Kapil 2008	2006	5-18	Both	6.70	0.60
Delhi	Kaur et al., 2008	2006	5-18	Boys	5.40	3.30
				Girls	4.20	1.60
Midnapore	Present study	2008-09	10-12	Boys	4.22	0.78
				Girls	7.20	0.80
				Both	5.69	0.79
Low income:						
Delhi	Kaur & Kapil 2008	2006	5-18	Both	1.41	0.20
Delhi	Marwaha et al 2006	INA	5-18	Boys	2.66	0.42
				Girls	2.14	0.28
Delhi	Kaur et al., 2008	2006	5-18	Boys	2.50	1.50
				Girls	2.30	0.90
Jaipur	Gupta et al., 2006	2003	11-17	Girls	2.30	0.30
Udaipur	Kaneria et al., 2006	2002	12-17	Both	1.60	0.00

INA = Information not available.

Table 4. Prevalence of overweight and obesity (defined by IOTF) by gender and country economic classification

Country	Reference	Study date	Age group (years)	Sex	Overweight (%)	Obesity (%)
High income:						
Australia	Magarey et al. 2001	1995	7–15	Boys	15.00	4.50
				Girls	15.80	5.30
Bahrain	Al-Sendi et al. 2003	2002	12–17	Boys	15.30	14.90
				Girls	24.50	17.90
Canada	Tremblay et al. 2002	1996	7–13	Boys	33.00	10.00
				Girls	27.00	9.00
Finland	Kautiainen et al. 2002	1999	12–18	Boys	19.00	2.70
				Girls	11.00	1.40
Greece	Krassas et al. 2001	2000	6–17	Boys	25.90	5.10
				Girls	19.10	3.20
Hong Kong	Ko et al 2008	2003-04	11-18	Boys	13.54	3.87
				Girls	6.72	1.79
Italy	Vignolo et al 2004	2001	6-16	Boys	39.11	11.15
				Girls	33.33	8.75
Japan	Matsushita et al 2004	1996-00	12-14	Boys	14.90	2.70
				Girls	11.20	1.00
Saudi Arabia	El-Hazmi & Warsy 2002	1994–98	1–18	Boys	10.68	5.98
				Girls	12.70	6.74
Switzerland	Zimmermann et al 2004	2002	6-12	Boys	16.60	3.85
				Girls	19.10	3.72
USA	Flegal et al. 2001	1988–94	12–17	Boys	28.00	8.00
				Girls	28.00	8.00
Upper–middle income:						
Brazil	Cole et al 2000	1989	2-25	Boys	4.70	0.10
				Girls	15.20	2.00
Mexico	del Rio-Navarro et al. 2004	2000	10–17	Boys	18.00	8.00
				Girls	21.00	7.00
Seychelles	Stettler et al 2002	1999	4-17	Boys	9.20	3.10
				Girls	15.90	4.50
Turkey	Oner et al 2004	2001-02	12-17	Boys	10.30	2.10
				Girls	11.30	1.60
Lower-middle income:						
China	Wang 2001	1993	10-18	Boys	3.00	1.80
				Girls	3.00	1.80
Iran	Kelishadi et al 2007	2003-04	6-18	Boys	5.40	1.60
				Girls	5.90	1.30
South Africa	Krugeri et al 2006	2000-01	10–15	Boys	4.10	1.50
				Girls	8.30	1.70
South Africa	Jinabhai et al 2007	2002	13–17	Boys	4.20	0.90
				Girls	20.8	4.50
India	Present study	2008-09	11-12	Boys	4.22	0.78
				Girls	7.20	0.80
Low Income:						
Nigeria	Ben Bassey et al ,2007	2004	10-19	Boys	1.90	0.10
				Girls	4.70	0.25
Senegal	Benefice 2004	1998-00	12-17	Boys	1.60	0.00
				Girls	0.00	0.00

In the present study, prevalence of overweight among girls was found to be higher than that of boys. The higher prevalence of overweight among girls in our study is consistent with the gender difference in other Indian studies (Kapil *et al.,* 2002; Marwaha *et al.,* 2006; Sidhu *et al.,* 2006). Similar results were also reported from different parts of the world (Stettler *et al.,* 2002; Kruger *et al.,* 2006; Ben-Bassey *et al.,* 2007; Stark *et al.,* 1981). This higher prevalence of overweight among girls may be related to the adolescent growth spurt and the effects of hormonal surge which occurs earlier in girls (Chhatwal *et al.,* 2004). A study from Israel found similar prevalence of obesity among boys and girls (Wang, 2001; Seidman *et al.,* 19891) as observed in the present study. On the contrary, several studies from India and abroad had reported higher prevalence of overweight and obesity among boys (Sharma *et al.,* 2007; Tremblay *et al.,* 2002; Kautiainen *et al.,* 2002; Vignolo *et al.,* 2004; Chhatwal *et al.,* 2004). All these studies clearly indicate that the sex of the child has an influence on the prevalence of overweight and obesity.

Among the many possible causes of higher prevalence of overweight and obesity among higher socioeconomic groups could be the role of change in the dietary pattern and physical activities with increase in income levels. However, one of the major limitations of most of these studies, including ours, is that they did not study in details the dietary intake and physical activity levels of the subjects.

In conclusion, our study indicated that the prevalence of overweight and obesity among middle income adolescents of Midnapore town was low. This finding is similar and consistent with earlier findings among middle income groups (in lower middle income countries) from other parts of the world including India. We recommend that similar studies be undertaken among children and adolescents of different socioeconomic groups of different ethnicities from diverse parts of India. Such studies would help us to have a better and clearer picture on the overweight and obesity situation in India. It may then be possible to draw an overweight/obesity map of children and adolescents of India. Since childhood/adolescent overweight and obesity is a strong precursor of adult obesity (Whitaker *et al.,* 1997), such a 'overweight/obesity map' would be of immense value in the formulation of health promotion and health intervention programs aimed at reducing the prevalence of overweight/obesity among different populations.

Acknowledgement: This study was supported by the University Grants Commission (UGC), India under the UGC-Dr. D. S. Kothari Post Doctoral Fellowship Scheme (F. 4-2 / 2006 (BSR) / 13-51 / 2008 (BSR)). All subjects who participated in this study are gratefully acknowledged.

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