Low Obesity and High Undernutrition Prevalence in Lower Socioeconomic Status School Girls: A Double Jeopardy

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INTRODUCTION

Childhood obesity is a new epidemic worldwide. In recent years due to burgeoning fast-food industry in developed countries the problem of obesity in children has emerged as a major problem and it has been estimated that more than 50% of children in USA and many Western European countries are either overweight of obese (WHO, 2000). In the US, prevalence of overweight doubled among children 6 to 11 years of age between the second National Health and Nutrition Examination Surveys (NHANES) between 1976 and 1980 and the third NHANES conducted in 1999 and 2000 (Dietz, 2004). A similar trend has been observed in Japan and the frequency of obese school children (>120% standard body weight) aged 6-14 years increased from 5% to 10% between 1974 and 1993 (WHO, 2000). In developing countries such as India, especially in urban populations, childhood obesity is emerging a major health problem (Shetty, 1999). Studies from metropolitan cities in India have reported a high prevalence of obesity among affluent school children (Sundaram et al., 1988; Gupta and Ahmed, 1990; Verma et al., 1994; Gupta et al., 1998; Kapil et al., 2002; Ramachandran et al., 2002; Subramanyam et al., 2002). On the other hand some studies reported a high prevalence of undernutrition among rural school children and children in urban slums (WHO, 2000; Sacdeva, 2003; Bhargava et al., 2004). It can be said that children in developing countries presently suffer from double jeopardy of malnutrition- urban children are afflicted with problems of over-nutrition while rural and slum children suffer from effects of under-nutrition (Chatterjee, 2002).

Changing trends in body weights in children is important for public health policy. This can be either evaluated using a prospective-study design or by sequential multiple cross sectional studies. We performed multiple cross section evaluations in a single school in Jaipur in North Western part of India to determine changing trends in body-mass index and obesity in school girls aged 11-17 years in classes 6th to 12th. We also used the recent criteria suggested by an international study group to classify obesity (Cole et al., 2000) in contrast to previous Indian studies which used body-mass index (BMI) > 95th percentile to diagnose obesity and > 85th percentile for overweight.

METHODS

All children being admitted to a semi-government girls' school in Jaipur were evaluated in the years 1997 and 2003. The school is situated in the walled-city of Jaipur and caters to low- and low-middle socioeconomic status families and is managed by a charitable trust with tacit support of the state government. All the parents consented to medical examination of their children.

History of medical illnesses, accidents and operations was recorded in a proforma. Height was measured to the nearest centimeter using a stadiometer and weight to the nearest half-kilo was measured using a well-calibrated spring balance. Children who agreed to a recent major illness (involving absence from school for more than 7 days in the past 6 months) were excluded from the present analysis.

***Statistical Analyses*:** The data were computerized. Body-mass index (BMI) was calculated by dividing weight in kg by squared height in metres. Numerical variables are reported as mean ± 1 SD. Inter-group comparisons were performed using analysis of variance (ANOVA) or t-test as appropriate. Prevalence of obesity was determined for each class and age-group using criteria as suggested by WHO (2000) as well as Williams et al. (2002) for American Heart Association (overweight 85-95th percentile, obesity > 95th percentile). Obesity was also determined using criteria suggested by an international study group (Cole et al., 2000) wherein overweight in children corresponds to adult BMI of 25-29.9 kg/m^2 and obesity corresponds to BMI > 30 kg/m^2. Prevalence of wasting (low weight-for-age), stunting (low height-for-age), or both was determined using criteria of Indian Council of Medical Research as reported previously (Sachdev, 1994). Inter-group comparisons in prevalence rates were performed

using χ^2 test. P values of <0.05 were considered significant.

RESULTS

We examined 1224 school girls in the year 1997 and 915 in the year 2003 in classes 6th to 12th. The age distribution and number of girls in each class is shown in Table 1. There is an increasing trend in height, weight and BMI with increasing age in both the years. There is a small increase in mean height and weight in the year 2003 as compared to the earlier year in various age groups but this is not significant. The mean BMI did not change significantly in any age-group between the two examinations.

The prevalence of obesity when determined using the percentile cut-offs is reported in Table 2. In the year 1997, 116 girls (10.9%) were overweight and 67 girls (5.5%) were obese while in the year 2003, 81 girls (10.5%) were overweight and 52 girls (6.7%) were obese (p= n.s.). The prevalence of obesity in different age-groups is also no significantly different in the two examinations. Prevalence of obesity determined using the recently revised international criteria (Cole et al., 2000) is reported in Table 3. Overweight corresponding to adult BMI of 25-29.9 kg/m^2 was present in 2.3% girls in both the examinations while the prevalence of obesity corresponding to adult BMI of >30 kg/m^2 was present in very small numbers (0.2% and 0.3%).

Table 3: Prevalence of overweight and Obesity (Cole's Criteria)

Age-group (yr)	*1997*			*2003*		
	No.	*Over-weight*	*Obese*	*No.*	*Over-weight*	*Obese*
11	186	4	0	129	1	1
12	129	3	0	116	3	2
13	171	3	0	109	4	0
14	222	5	0	114	7	0
15	177	2	0	147	3	0
16	179	4	1	149	2	0
17	161	7	1	145	1	0
Total	1224	28 (2.3)	2 (0.2)	915	21 (2.3)	3 (0.3)

We also determined the prevalence of under-nutrition using the Indian Council of Medical Research criteria (Sachdev, 1994). These criteria classify wasting when height-for-age is > 90% and weight-for-age is < 80% of standard; stunting when height is < 90% and weight > 80% and combined wasting and stunting when height is < 90% and weight is < 80%. At all the age-groups there was a high

Table 1: Anthropometric Indices in different age-groups in 1997 and 2003

Age-group (yr)	*1997*				*2003*			
	No.	*Height (cm)*	*Weight (kg)*	*BMI (kg/m^2)*	*No.*	*Height (cm)*	*Weight (kg)*	*BMI (kg/m)*
11	186	139.2±8.1	28.9±5.9	14.8±1.9	129	143.9±7.2	32.6±2.2	15.0±2.2
12	129	143.9±7.4	32.6±6.6	15.7±2.4	116	144.0±8.2	32.8±7.0	15.7±2.7
13	171	148.1±7.4	35.9±6.5	16.3±2.3	109	151.8±6.1	37.4±7.4	16.2±2.7
14	222	152.0±5.9	39.1±6.5	16.9±2.6	114	154.2±6.0	41.1±7.4	17.3±2.8
15	177	153.8±6.3	40.6±6.1	17.2±2.3	147	156.6±6.0	42.9±7.0	17.5±2.8
16	179	154.5±6.3	43.7±7.0	18.3±2.9	149	157.1±5.7	44.9±7.6	18.2±2.7
17	161	156.6±6.1	45.9±8.2	18.8±3.3	145	156.5±5.4	44.0±5.7	18.0±2.5
Total	1224	149.7±6.3	38.1±6.0	16.9±1.4	915	152.0±5.8	39.4±5.2	16.8±1.2

Table 2: Prevalence of overweight (BMI > 85th to 95th percentile) and obesity (BMI >95th percentile)

Age-group (yr)	*1997*			*2003*		
	No.	*Overweight*	*Obese*	*No.*	*Overweight*	*Obese*
11	186	20 (10.8)	9 (4.8)	129	14 (10.9)	7 (5.4)
12	129	14 (10.9)	7 (5.4)	116	9 (7.8)	6 (5.1)
13	171	11 (6.4)	13 (7.6)	109	11 (10.1)	6 (5.5)
14	222	22 (9.9)	12 (5.4)	114	10 (8.7)	8 (7.0)
15	177	16 (9.0)	9 (5.1)	147	15 (10.2)	7 (4.8)
16	179	18 (10.5)	9 (5.0)	149	11 (7.4)	8 (5.4)
17	161	15 (9.3)	8 (5.0)	145	11 (7.6)	10 (6.9)
Total	1224	116 (10.9)	67 (5.5)	915	81 (10.5)	52 (6.7)

prevalence of wasting in both the examinations, in 1997 wasting was present in 443 girls (36.1%) and in the year 2003 in 254 girls (27.7%). Prevalence of stunting alone as well as combined wasting and stunting was low (Table 4). There was a significant decline in prevalence of wasting from the year 1997 (36.1%) to the year 2003 (27.7%) ($p < 0.01$). Prevalence of stunting (0.2% vs. 0.3%) and combined wasting and stunting (4.3% vs. 2.7%) did not show any significant change (p= n.s.) (Fig. 1).

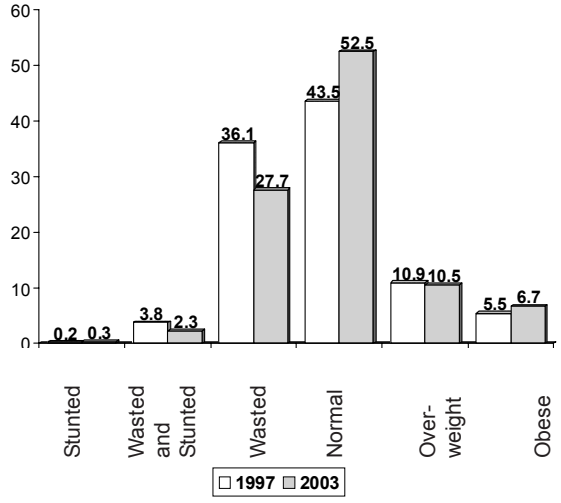

Fig. 1. Prevalence of underweight, normal weight and overweight children in years 1997 and 2003. Ther e is no significant change in prevalence of severe underweight (wasted and stunted or stunted) and overweight (overweight and obese) girls while a significant decline is noted in the prevalence of wasting (moderate undernutrition) and an increase in normal weight. A rightward shift of the standard normal curve is apparent, indicating better nutrition.

DISCUSSION

The present study shows that in a semi-government school catering to low socioeconomic subjects there is a low prevalence of overweight and obesity while the prevalence of under-nutrition diagnosed by low weight-for-age is high among girls.

Childhood obesity is not confined to developed countries and high rates have been reported from many developing countries. The prevalence of obesity among school children aged 6-12 years in Thailand diagnosed by weight-for-height exceeding 120% of the Bangkok reference data increased from 12.2% in 1991 to 15.6% in 1993 (WHO, 2000). In a study of 6-18 years male schoolchildren in Saudi Arabia the prevalence of obesity was found to be 15.8% (WHO, 2000). Integrated data on prevalence of obesity in children have been compiled by the WHO Programme of Nutrition (WHO, 2000). In this WHO analysis, children aged 1-5 years were classified as obese when they exceeded the US National Centre for Health Statistics (NCHS) median weight-for-height plus two standard deviations or Z-scores. The prevalence of obese children varied from less than 1% in Bangladesh and Philippines, about 2% in India, Brazil, and Indonesia to more than 5% in Iran, Jamaica and Chile. Our study is confined to girls aged 11-17 years and reports a higher prevalence of obesity. The prevalence of overweight and obesity has not changed over a period of 6 years in contrast to studies from Thailand.

In recent years many studies have reported on prevalence of obesity in school children in various parts of India (Sachdeva, 2003). Sundaram et al. (1988) reported a low prevalence of obesity among

Table 4: Prevalence of Under-Nutrition

Age-group (yr)	*1997*					*2003*				
	No.	*Normal or overweight*	*Wasted*	*Stunted*	*Wasted and stunted*	*No.*	*Normal or overweight*	*Wasted*	*Stunted*	*Wasted and stunted*
11	186	73	98	0	15	129	77	47	0	5
12	129	46	70	0	13	116	34	64	2	16
13	171	91	67	1	12	109	63	46	0	0
14	222	137	82	0	3	114	104	10	0	0
15	177	116	60	0	3	147	119	28	0	0
16	179	134	44	1	0	149	116	33	0	0
17	161	139	22	0	0	145	119	6	0	0
Total	1224	736 (60.1)	443 (36.1)*	2 (0.2)	46 (3.8)	915	632 (69.1)	254 (27.7)*	2 (0.3)	21 (2.3)

*P<0.01

rural school children. Gupta and Ahmad (1990) diagnosed obesity using the standard criteria of BMI > 85th percentile for overweight and > 95th percentile for obesity and reported obesity in 7.8% of school children (n = 3861) in north India. Gupta et al. (1998) studied 237 school children aged 13-17 years for prevalence of multiple atherosclerosis risk factors. Obesity diagnosed by BMI > 90th percentile was present in 10.1%. Kapil et al. (2002) studied 563 boys and 307 girls in a Delhi private school and reported overweight in 24.7% and obesity in 7.4% children. Ramachandran et al. (2002) studied 4700 school children aged 13-18 years studying in affluent schools in Chennai. The age-adjusted prevalence of overweight and obesity was reported as 17.8% in boys and 15.8% in girls. Subramanyam et al. (2003) studied obesity trends in adolescent girls studying in affluent private schools in Chennai. In the year 1981(n = 707) overweight was present in 9.6% and obesity in 5.9% while in the year 1998 (n = 610) overweight was in 9.7% and obesity in 6.2%, there was no significant change in the prevalence of obesity. In the present study, the obesity prevalence rates are lower than the studies from affluent public schools in Delhi and Chennai. Bhargava et al. (2004) recently reported data from a population-based birth cohort is Delhi. In a low socioeconomic status children population the mean BMI in 864 boys and 623 girls aged 12 years was 15.6 ± 2.0 and 16.0 ± 2.0 kg/m^2 respectively. Our study in a low socioeconomic status school also shows that mean BMI at 12 years of age is 15.7± 2.4 and 15.7 ± 2.7 and is similar to the low socio-economic subjects in Delhi. There is also unchanged trends in prevalence of overweight (10.9% in 1997, 10.5% in 2003) and obesity (5.5% in 1997, 6.7% in 2003) in girls aged 11-17 years.

The criteria for diagnosis of obesity in children have been criticized recently (Bailey and Ferro-Luzzi, 1995; Cole et al., 2000). The > 85th percentile for overweight and > 95th percentile for obesity have been derived from the data from NCHS and NHANES in USA and studies western European countries where BMI > 95th percentile corresponds to >130% ideal body weight and BMI of > 30 kg/m^2 (WHO, 2000). Cole et al. (2000) combined data from several European and Asian countries to determine childhood BMI that correspond to adult BMI of 25 kg/m^2 and 30 kg/m^2. Detailed age-specific algorithms were developed and it was recommended that these criteria should be used for diagnosis of obesity. Using these criteria in the present study shows that obesity is present in only a small number of Indian school children. This indicates that either the previous criteria were more liberal in diagnosis of obesity or the Cole's criteria are not applicable to Indian and South Asian children. Significantly, there were no data from India or other developing countries in the Cole's meta-analysis and it is suggested that revised norms using data from many developing countries should be developed (WHO, 2004).

STUDY IMPLICATIONS

It has been prophesied that obesity with its attendant health consequences and consequent health burden is expected to reach epidemic proportions in developing countries like India, especially among the affluent (Shetty, 1999). The poor shall continue to suffer from ill-effects of under nutrition and this would impose a double burden on healthcare systems (Chaterjee, 2002; Adusumilli and stiles, 2003). More studies targeting the child and adolescent populations in different parts of the country are needed to accurately assess the burden of obesity and undernutrition and to devise suitable population health policy.

There is evidence in India already that within the urban population there are large disparities in nutritional status of children. We studied girls in three schools belonging to different socioeconomic groups, a slum-based government school (very low SES), a low socioeconomic status school (present study, Low SES) and a middle socioeconomic private school (Mid SES) (Fig. 2). It is observed that with increasing age in girls in very low SES and mid-SES schools there is insignificant change in body-mass index and

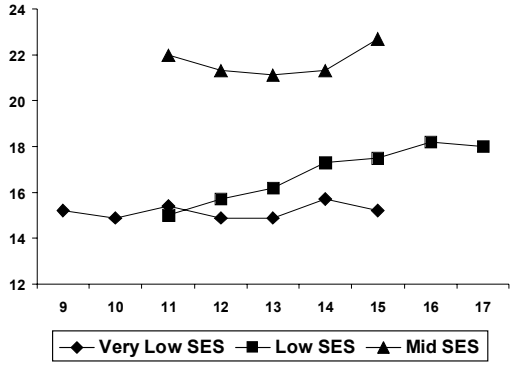

Fig. 2. Correlation of body mass index (BMI) with increasing age in different socioeconomic status (SES) school girls in Jaipur. In a very low SES slum-based schoolgirls (n= 135) the BMI was low and did not increase significantly with age while in the upper-middle SES schoolgirls (n= 90) the BMI was high and also did not increase significantly with age. Among girls in the present study in 2003 (n= 915) there was a significant increase in BMI with increasing age (p for trend <0.05).

very-low status girls remain underweight and middle status girls remain overweight but in the low SES school girls there is a significant increase in body-mass index with increasing age. It appears that this population, which forms a very large group in India and many other developing countries, destined to face a double burden of underweight and overweight related problems.

The coexistence of underweight and obesity poses a challenge to public health programs since the aim of programs to reduce undernutrition are in conflict with those of obesity prevention (Caballero, 2005). As pointed by Doak et al. (2005), these programs will have to identify and consider the magnitude and demographic composition of dual-burden societies at the local and regional levels and then develop more targeted interventions. It will be essential to educate health workers about the underweight-overweight phenomenon. Some important interventions for reducing the rate of under nutrition may also be beneficial in terms of reducing the burden of obesity. These interventions could be promoting breast feeding, improving nutritional status of women of reproductive age, and reducing the rates of fetal growth retardation and low birth weight (Chaterjee, 2002; Caballero, 2005).

On the other hand reducing the obesity-producing environment in urban areas of developing countries may be more challenging. Government and nongovernmental organizations must play an active role in promoting and protecting an environment that supports the growth and development of infants and children, monitoring the food markets, and facilitating community-based initiatives that aim to promote healthy eating and physical activity. The other major challenge that encompasses the root cause of the problem is to reduce socioeconomic and health disparities in urban areas of developing countries such as India. Macroeconomic and public health initiatives are urgently needed in the country to achieve a balance.

REFERENCES

Adusumilli, P.S. and Stiles, B.M.: Obesity epidemic in the West: warning signs in the East. *Natl. Med. J. India*, **16:** 110-111 (2003).

Bailey K.V. and Ferro-Luzzi, A.: Use of body mass index of adults in assessing individual and community nutritional status. *Bull. WHO*, **73:** 673-680 (1995).

Bhargava, S.K., Sachdev, H.P.S., Fall, C.H.D., Osmond, C., Lakshmy, R., Barker, D.J.P., Biswas, S.K.D., Ramji, S., Prabhakaran, D. and Reddy, K.S.: Relation of serial changes in childhood body-mass index to impaired glucose tolerance in young adulthood. *N. Engl. J. Med*., **350:** 865-875 (2004).

Caballero, B.: A nutrition paradox: underweight and obesity in developing countries. *N. Engl. J. Med.,* **352:** 1514-1516 (2005)

Chatterjee, P.: India sees parallel rise in malnutrition and obesity. *Lancet,* **360:** 1948 (2002).

Cole, T.J., Bellizzi, M.C., Flegal, D.M. and Dietz W.H.: Establishing a standard definition for child overweight and obesity worldwide: international survey. *B.M.J,* **320:**1240-1243 (2000).

Dietz, W.H. Overweight in childhood and adolescence. *N. Engl. J. Med.,* **350:** 855-857 (2004).

Doak, C.M., Adair, L.S., Bentley, M., Monteiro, C. and Popkin, B.M.: The dual burden household and the nutrition transition paradox. *Int. J. Obes.,* **29:** 129-136 (2005).

Gupta, A.K. and Ahmad, A.J. Childhood obesity and hypertension. *Indian Pediatr*., **27:** 333-337 (1990).

Gupta, R., Goyle, A., Kashyap, S., Agarwal, M., Consul, R. and Jain BK.: Prevalence of atherosclerosis risk factors in adolescent school children. *Indian Heart J.,* **50:** 511-515 (1998)

Kapil, U., Singh, P., Pathak, P., Dwivedi, S.N. and Bhasin, S.: Prevalence of obesity amongst affluent adolescent school children in Delhi. *Indian Pediatr.,* **39:** 449-452 (2002).

Ramachandran, A., Snehalatha, C., Vinitha, R., Thayyil, M., Kumar, C.K., Sheeba, L., Joseph, S. and Vijay, V.: Prevalence of overweight in urban Indian adolescent school children. *Diab.Res. Clin. Pract.,* **57:** 185-190 (2002).

Sachdev, H.P.S.: Assessment of nutritional status. In: *Nutrition in Children: Developing Country Concerns*. H.P.S. Sachdev and P. Choudhury (Eds.). Maulana Azad Medical College, New Delhi (1994).

Sachdev, H.P.S.: Recent transitions in anthropometric profile of Indian children: clinical and public health implications. *N.F.I. Bull.,* **24**: 6-8 (2003).

Shetty, P.S.: Obesity in children in developing societies: indicator of economic progress or a prelude to a health disaster? *Indian Pediatr.,* **36:**11-15 (1999).

Subramanyam, V., Jayashree, R. and Rafi, M.: Prevalence of overweight and obesity in affluent adolescent girls in Chennai in 1981 and 1998. *Indian Pediatr.,***40**: 775-779 (2003)

Sundaram, K.R., Ahuja, R.K. and Ramachandran, K.: Indices of physical build, nutrition and obesity in school-going children. *Indian J Pediatr.,* **55:** 889-898 (1988).

Verma, M., Chhatwal, J. and George, S.M.: Obesity and hypertension in children. *Indian Pediatr.,***31:** 1065-1069 (1994).

Williams, C.L., Hayman, L.L., Daniels, S.R., Robinson, T.N., Seinberger, J., Paridon, S. and Bazzarre, T.: Cardiovascular health in childhood. *Circulation,* **106:**143-160 (2002).

WHO Consultation.: Obesity: preventing and managing the global epidemic. *WHO Tech. Rep. Ser.,* **894:** 1-37 (2000).

WHO Expert Consultation.: Appropriate body mass index for Asian populations and its implications for policy and intervention strategies. *Lancet,* **363:** 157-163 (2004).

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ABSTRACT Despite the escalating problem of obesity, underweight remains a major problem in developing countries and currently these countries are facing a double burden of nutrition related conditions. To determine the prevalence of obesity as well as underweight in school children belonging to a low socioeconomic status we performed serial studies in a girls' school. All students from class 6th to 12th (age range 11-17 years) who did not have a recent major illness were evaluated for height and weight. Body mass index (BMI) was calculated. Undernutrition was diagnosed using the Indian Council of Medical Research guidelines. Prevalence of obesity was determined using > 95th percentile BMI cut-off and overweight between 85th and 95th percentile. A recently proposed age-specific BMI cut-off suggested by a World Health Organisation study group was also used to determine obesity in these children. 1224 girls were examined in 1997 and 915 in 2003. The mean BMI in the two years was 16.9 ± 1.4 and 16.8 ± 1.2 kg/m^2. The overall prevalence of overweight was 10.9% and 10.5% and obesity was 5.5% and 6.7% in 1997 and 2003 respectively (p= n.s.). Using the newer age-specific criteria overweight was diagnosed in 2.3% in both examinations and obesity in 0.2% and 0.3% respectively (p = n.s.). There was a high prevalence of wasting in both the examinations although there was a decline in its prevalence (36.1% in 1997 and 27.7% in 2003, $p < 0.01$). Prevalence of overweight and obesity in low socioeconomic schoolgirls is lower than previously reported Indian studies from metropolitan cities. Prevalence of wasting as a marker under nutrition is high although there is a decline in its prevalence in serial examinations.

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