USING SOCIO-ECONOMIC STATUS AND MEDIA USE TO PREDICT EXCESS WEIGHT IN ADOLESCENT GIRLS ATTENDING SCHOOL IN KOLKATA, INDIA

by

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ABSTRACT

The health problems associated with obesity and overweight have been recognized as public health problems affecting populations worldwide. Increases in the prevalence of obesity are documented in all ages, in both developed and developing countries. Younger age groups deserve particular attention in obesity prevention since the long-term consequences of overweight persist into adulthood. This study draws on data collected from the Kolkata Girls' Health Survey, a cross-sectional study examining health issues of girls in Kolkata, India (n=373). The objective of this study was to examine socio-economic status and media use as predictors of overweight. Results: A higher level of parental educational attainment was significantly associated with overweight. Greater levels of media use were associated with higher socio-economic status, but not with overweight. Subsequent analyses need to explore other aspects related to socio-economic status such as diet and physical activity, which are likely to contribute to overweight in adolescent girls.

Keywords: overweight; obesity; adolescents; India; socioeconomics; media

Subject Terms: obesity in adolescents; obesity risk factors; obesity social aspects

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INTRODUCTION AND BACKGROUND

Obesity is an issue worldwide

Obesity is a risk factor for many serious health conditions and diseases. Excess weight is strongly linked with hypertension, coronary heart disease, type II diabetes, stroke, arthritis, some cancers, and mental health issues (e.g. low self-esteem, depression) (Health Canada, 2007). It is projected that by 2020 non-communicable diseases such as cancer and circulatory diseases will cause 80% of deaths in the developing world, and of these deaths, three-quarters will be from cardiovascular diseases (Leeder et al., 2004). Obesity is deserving of public health attention because it is a modifiable risk factor for many conditions and diseases, and can be addressed through a wide range of individual and population-based approaches. Even a 10 to 20 percent reduction in weight can drastically reduce the risk of developing certain diseases (Health Canada, 2007).

In 1997, the World Health Organization (WHO) recognized obesity as a global epidemic in need of urgent public health action (WHO, 1997). More then ten years later, the prevalence and incidence of obesity and overweight is still increasing globally, in both economically developed and developing countries (Baharti et al., 2007; Kaur et al., 2005). On a world scale, overweight affects an estimated 1.3 billion adults and 10% of youth aged 5-17 years (Lobstein et al., 2004).

Excess weight in children, youth, and adolescents is of particular concern. Since the 1980's obesity rates among young Canadians and Americans have reached epidemic proportions and continue to rise exponentially (Shields, 2005; Dietz, 2004). For Canadians aged 12 to 17, the combined overweight/obesity rate more than doubled from 14% in 1981 to 29% in 2004, and the obesity rate alone tripled from 3% in 1981 to 9% in 2004 (Shields, 2005). Data from developing countries is limited; however, a substantive increase in rates of youth/adolescent obesity and overweight has also been documented in developing nations such as Thailand and China (Wang & Lobstein, 2006; Mo-Suwan, 1993, as cited in Bose et al., 2007).

The obesity epidemic is largely environmental in nature. There is no clear evidence of a genetic cause since the rise in obesity only began to surface in the last fifty years and genetic changes take many more years to have an impact. Although some individuals/groups may be genetically predisposed to obesity and its related conditions, environmental and lifestyle factors are key determinants. According to the WHO (1997), "the global epidemic of obesity is a reflection of massive social, economic, and cultural problems currently facing developing and newly industrialized countries, as well as ethnic minorities and the disadvantaged in developed countries" (WHO, 1997, p.4). Overall, large-scale nutritional and societal changes relating to economic growth, the globalization of markets, and modernization are factors contributing to the obesity epidemic (McLaren, 2007; Raymond et al., 2006).

In every age group, the increase in obesity can be explained by factors that directly affect diet and physical activity. Studies have focused primarily on examining the role between obesity and increases in sedentary behaviour and media use/screen time (television, computer, video game, radio), decreases in physical activity, and the consumption of unhealthy foods – namely, convenience, processed and fast foods (Fotheringham et al., 2000; Tremblay & Williams, 2003). In developing nations, in addition to the factors mentioned above, rising affluence and urbanization also contribute to growing rates of obesity by influencing diet and physical activity level (Chhatwal et al., 2004; Monteiro et al., 2004b).

Research also links socio-economic status (SES) to obesity; however, the pattern appears to differ in developed and developing nations. In the developed world there is an inverse relationship between SES and overweight/obesity – those of lower SES are more likely to be overweight compared to those in higher SES groups. A positive relationship between SES and obesity exists in developing nations whereby obesity increases as SES increases (Sobal & Stunkard, 1989; Monteiro et al., 2004a; Mendez et al., 2005; McLaren, 2007). It is also important to note that recent trends in some developing countries suggest that the rise in obesity prevalence appears to be shifting from the higher to lower socio-economic levels (Caballero, 2007; Monteiro et al., 2004b). Specific to children and youth, a review by Wang and Lobstein (2006) confirmed that the childhood obesity epidemic is increasing rapidly and significantly among children in developing countries, especially among those in urban centres and who follow a Western lifestyle.

Obesity as a risk factor for morbidity and mortality in India

India is already experiencing the burden associated with chronic diseases, most of which are linked to excess weight. Cardiovascular disease is the leading cause of death in India, and the prevalence of diabetes is expected to rise from 19.4 million in 1995 to 57.2 million by 2025 (Raymond et al., 2006; King et al., 1998). Migrant studies on adults in the United States show that compared to Caucasians, South Asians are more susceptible to insulin resistance (a pre-diabetic condition) and metabolic syndrome (a set of metabolic conditions deriving from insulin resistance that increase the risk of developing diabetes, heart disease, and stoke) (Banerji et al., 1999; Chandalia et al., 1999).

Of note is the increasing prevalence of type II diabetes in younger populations in India. In 1986, a study in Delhi reported that of type II diabetics, none were under the age of 30; however, in 2001, 5.4% of people under the age of 30 had type II diabetes (Sandeep et al., 2007). More recently, Misra and colleagues (2004) found that 27% of postpubertal Indian youth were insulin resistant (a risk factor for the development of type II diabetes). Rises in obesity in youth are also associated with increases in the incidence of metabolic syndrome. (Singh et al., 2007a).

Preventing and reducing overweight in Indian populations is needed to improve quality of life and reduce the burden of chronic diseases. Focusing prevention and treatment efforts on youth and adolescent populations in India is of particular importance given research evidence supporting the fact that chronic conditions are beginning to affect people of younger ages.

Obesity and India's economy

According to the World Bank, India's economy is growing at a rapid pace. India is currently the world's fourth largest economy in purchasing power parity terms, and over the last three years, has had an average economic growth rate of 8% (World Bank, 2007). In comparison, Canada's average economic growth rate is approximately 1% (Statistics Canada, 2008). Economic development has contributed to income growth in India, now making it possible for some groups to replace traditional, fibre rich diets, with unhealthy foods. In urban areas, city growth, combined with greater educational curriculum demands, are detrimental to the health of young Indians - leaving children and youth with less space or time for physical activity (Chhatwal et al., 2004). Specific facets of urbanization, such as improvements to and expansion of public transportation, also contribute to obesity by decreasing active transport, one form of physical activity (Caballero, 2005). The availability of various forms of media also accompanies economic development and urbanization, and its usage is heightened further by the introduction and increasing affordability of satellite television, personal computers, and other multimedia/entertainment devices (Varma, 2000).

India's economy is implicated as a force contributing to the rise of obesity; however, excess weight and the chronic conditions with which it is associated must be addressed in order to help sustain economic growth and development in

India. The growing economy is important to help address other issues faced by the Indian subcontinent - namely poverty, malnutrition and communicable diseases such as HIV/AIDS (WHO Regional office for South-East Asia, 2007).

Obesity is also beginning to stand out as an emerging policy issue due to the large healthcare and economic costs with which it is associated. Direct costs are immediate to the health care system (or to the privately paying individual/family) and involve diagnosing, and treating obesity and obesity-related diseases (Sidell, 1999). From an economic and societal standpoint, indirect costs relating to obesity are also concerning. Losses to productivity due to greater rates of absenteeism, disability leave, and premature death/retirement are all indirect costs (Sidell, 1999). Preventing and reducing the prevalence of obese and overweight will reduce healthcare costs and other economic expenses.

According to Raymond and colleagues (2006), 25% of cardiovascular mortality in India occurs in working-age people, and this number is likely to increase with the rise in child/youth obesity. Preventative action is needed - "without attending vigorously to the spread of the risk factors [overweight, obesity, poor diet, physical inactivity] and consequent cardiovascular death rates, the window of opportunity will close without the reinvestment needed to sustain growth… Economic progress to date will once again be at risk as nations begin to pay for their growing elderly populations" (Raymond et al., 2006, p.115). In 2001, 22% of India's population was comprised of young adults aged 10-19, and 35% of the population was under the age of 14 (Register General & Census Commissioner of India, 2007). With more than 225 million Indians in their teenage years approaching working age, there is an urgent need to understand the burden of excess weight in this future adult population, and take immediate action towards prevention and control. Focusing efforts on this group will help to improve public health overall in the near and distance future.

Obesity research in India

Compared to other risk factors for morbidity and mortality, such as poverty and infectious diseases, obesity and overweight is not well understood or researched in developing economies like India because the growing prevalence of obesity is emerging at a time when under-nutrition remains a significant problem (Griffiths & Bentley, 2001). In recent years, more studies have begun to explore overweight and obesity in adult populations; however, little attention is given to childhood obesity in India, and even less attention is paid to adolescent populations. There are no nationally representative studies on adolescent obesity in India; most studies focus on smaller groups of young adults in a specific state or region.

A literature search was conducted using MEDLINE (via EBSCOHost) and Web of Science. Literature relevant to overweight/obesity in India was restricted to studies and articles on populations in India, published in the last 10 years. Grey literature from relevant government and organization websites was also searched and reviewed. Table 1 presents a selection of studies examining the prevalence of overweight and obesity in adult populations.

Table 1. A selection of research studies: prevalence of overweight and obese adult males and females in India

Region (urban/rural/mix)	N	Data Source (year of collection)	Age range	Sex of participants	Adiposity measure	%Overweight Male	%Overweight Female	%Obese Male	%Obese Female	Reference
26 states * (mix)	81712	India National Family Health Survey 2 ‡ (NFHS 2) (1998-99)	15-49	Female	BMI		9.4		2.6	Baharti et al., 2007
Delhi * (urban)	3428	Cross-sectional research study (1996-98)	18+	Male & Female	BMI	16.9	21.7	3.8	7.7	Chhabra & Chhabra, 2007
Andhra Pradesh-state * (mix)	4032	NFHS 2 (1998-99)	15-49	Female	BMI		12.0		2.0	Griffiths & Bentley, 2001
Karnataka- state* (mix)	4374	NFHS 2 (1998-99)	15-49	Female	BMI		11.0		3.0	Griffiths & Bentley, 2005
5 urban centres †		Cross-sectional research study (n.d)	25-64	Female	BMI					Singh et al., 1999
Moradabad	902						45.9		13.0	
Trivandrum	760						56.0		12.1	
Calcutta (Kolkata)	410						58.3		13.2	
Nagpur	405						52.1		11.8	
Bombay	780						47.4		14.2	
29 states * (urban)	59670	NFHS 3 (2005-06)	15-49	Male & Female	BMI	15.9	23.5	2.4	6.1	WHO Global Infobase, 2007
29 states * (rural)	117854	NFHS 3 (2005-06)	15-49	Male & Female	BMI	5.6	7.4	0.6	1.3	WHO Global Infobase, 2007

* Overweight classified as BMI >25-29.9kg/m^2, Obesity classified as BMI>30kg/m^2

† Definitions of overweight and obesity differ from other studies: Overweight = BMI >23kg/m^2, Obese = BMI > 27kg/m^2

‡ India's National Family Health Survey is representative at both the national and state level. Three cycles have been completed in total; the most recent cycle is the 2005-2006 NFHS-3 (National Family Health Survey, n.d.)

Most research on obesity in India has explored the prevalence in adult populations, and some studies have also examined the factors with which excess weight is associated. The majority of studies demonstrate that women, people living in urban areas, and those of higher socio-economic status (SES) are more overweight and obese. Although the evidence supporting these trends is consistent, more exploration is needed to explain why (and how) women, urban residents, and those of higher SES experience greater rates of obesity.

Adolescence is a critical period related to body growth and development, yet overall, compared to adult populations, fewer studies have examined overweight in younger populations in India. In recent years, more research efforts have been directed towards younger Indian populations; however, in comparison to studies on adults, adolescent research studies have smaller sample sizes and are not representative at a national or state level.

Table 2 presents a summary of studies published in the past 5 years that explore overweight and obesity in youth/adolescent populations in urban centres across India.

Table 2. Summary of research studies: prevalence of overweight and obese youth and adolescents in urban centres in India

Urban centres	N	Data Source (year of collection)	Age range	Sex of participants	Adiposity measure	%Overweight		%Obese		Reference
						Male	Female	Male	Female	
Ludhiana ‡	2008	Cross-sectional research study (1999)	9-15	Male & Female	BMI	15.7	12.9	12.4	9.9	Chhatwal et al., 2004
Hyderabad *	1208	Cross-sectional research study (2003)	12-17	Male & Female	BMI	6.1	8.2	1.6	1.0	Laxmaiah et al., 2007b
Delhi *	414	Cross-sectional research study (2002)	16-17	Female	BMI		15.2		5.3	Mehta et al., 2007
Chennai *	4700	Cross-sectional research study (2000)	13-18	Male & Female	BMI	17.8	15.8	3.6	2.7	Ramachandran et al., 2002
Delhi *	4399	Cross-sectional research study (2000-03)	12-14 15-17	Male & Female	BMI	31.1 22.9	22.2 15.7	5.7 2.8	2.9 0.3	Sharma et al., 2007
Chandigarh *	1083	Cross sectional research study (2003)	12-17	Male & Female (combined)	BMI	5.5		4.0		Singh et al., 2007a

‡ Overweight classified as age and sex specific BMI >85-95th percentile, Obesity as >95th percentile as per WHO standards
* Overweight classified as age and sex specific BMI >85-95th percentile, Obesity as >95th percentile as per Cole/IOTF standards (Cole et al., 2000)

Unlike adult populations, the sex patterning of overweight and obesity is not consistent in teenage populations. Studies on adolescents demonstrate mixed results on whether adolescent males or females are more overweight/obese, or if there is a difference at all. Similar to adult populations, rural and urban differences exist in adolescent obesity rates. A study by Mohan and colleagues (2004) explored the prevalence of overweight in the Punjab state and found that more urban adolescents were overweight compared to their rural counterparts (11.6% vs. 4.7%) (as cited in Kaur et al., 2005). The relationship between SES and obesity in adolescents also follows a pattern similar to adults in India. Several studies show increases in obesity and overweight as SES increases (Laxmaiah et al, 2007a; Kaur et al., 2005; Chhatwal et al., 2004). A variety of proxy measures are used to measure SES in these studies, including, parental residential ownership, household possession of articles, parental occupation, residential status, and per capita income of residential area.

As Mehta and colleagues (2007) note, "despite the fact that obesity or overweight in childhood has been linked to subsequent morbidity and mortality in adulthood, there is a paucity of studies on the prevalence of obesity amongst affluent adolescent girls in India" (p.620). This fact is surprising considering studies on adults suggest that women, those living in urban centres, and people of high SES are particularly prone to excess weight and its associated conditions.

Focusing on adolescent girls in India is warranted given that obesity among this population has increased over the last 25 years. A study by

Subramanyam and colleagues (2003) compared two groups of adolescent girls in India, one sample from 1981, and the other 17 years later, in 1998.

Table 3. A comparison of BMI cut-off points using 95th percentile as a measure of obesity: comparing two samples of adolescent girls, 1981 vs. 1998 (Subramanyam et al., 2003)

Age (years)	BMI 95th percentile (1981)	BMI 95th percentile (1998)	BMI 95th percentile (current international std.) (Cole et al., 2000)
10	20.00	22.04	24.11
11	21.97	22.95	24.42
12	21.17	23.26	26.67
13	23.40	27.23	27.76

Comparing body mass index (BMI) percentiles, the rise in obesity is evident from the change in the 95th percentile cut-off point. Table 3 demonstrates that adolescents at the 95th percentile of BMI in 1998 were heavier than adolescents in the same percentile of BMI in 1981. The 1981 and 1998 BMI cut-points for the 95th percentile are also shown in comparison to current internationally used BMI cut-points established by Cole and colleagues (2000). When current cut-points are compared to historical cut-points of the same percentile, current cut-points are larger which suggests that adolescent girls in India are even heavier today than in the past, at least at the high end of the BMI distribution (Table 3).

Although research on obesity in adolescents in India is limited, studies to date and evidence from other age groups suggest that obesity is an emerging public health issue, especially among women, urban populations, and those of higher SES. Without adequate research on youth and adolescents, the obesity epidemic confronting India can only be described and combated by relying on information gathered from adult populations.

PURPOSE/RATIONALE

This study will estimate the prevalence of overweight and obesity among adolescent girls attending English medium high schools in Kolkata, India, and examine socio-economic status and media use as predictors of excess weight.

Given the tendency for women, people in urban settings, and those of higher SES to be overweight, this study focuses on upper-class teenage girls in the city of Kolkata to gain insight into how obesity can be prevented in these at-risk groups. In addition, research from developed countries suggests that an overwhelming majority of overweight children/youth/adolescents become obese adults (Whitaker et al., 1997; Lobstein et al., 2004). If a similar pattern exists in developing nations, it is likely that in the next few decades India will face a population health crisis of overweight and obesity similar to (or higher than) that presently observed in North America and other developed countries. An effective way to prevent adult obesity, and the negative health outcomes with which it is associated, is to prevent overweight in young adults.

A fundamental step in prevention and control of obesity is the identification of risk factors and mediating pathways contributing to increases in weight. Media use and screen time have been linked to obesity in studies on adolescent girls in both developed and developing countries (Marshall et al., 2004; Boone et al., 2007; Schneider et al., 2007). Media use/screen time usually refers to television, video, movie, computer, and videogame usage. This study will explore whether a similar link can be made in adolescent girls in India.

In addition, as described, a gradient between SES and obesity has been observed in adult Indian populations, and this relationship will be a focus of the present study. Examining the link between weight and SES is important, considering that the current research and policy context is one where the increasing prevalence of overweight/obesity worldwide is occurring simultaneously with greater public awareness of, and research interest in, the social determinants of health. Examining and understanding social inequalities that affect health is an important topic on the international health agenda in helping to set public health priorities. In fact, WHO's Commission on the Social Determinants of Health will complete three years of work this year, in May of 2008 (WHO Commission on the Social Determinants of Health, 2008).

METHODS

Sample and study design

This study uses data from the Kolkata Girls' Health Project. The purpose of the larger cross-sectional study was to identify the priority health issues of girls attending two schools in Kolkata, India. The survey aimed to elucidate and increase understanding of (a) factors that influence the health of adolescent girls; (b) health related behavioural patterns of adolescent girls in Kolkata; (c) how adolescent girls in Kolkata are currently obtaining health information, and (d) the prevalence of various health issues among girls in school in Kolkata. Data for the Kolkata Girls' Health Project was collected using a school-based survey in April of 2007. The present study uses self-reported information relating to demographics, media use, and height and weight. Simon Fraser University's Ethics Committee granted approval for the larger study, and written parental/guardian consent was obtained for all students who took part in the survey, as well as from the girls themselves.

The overall study sample consisted of 610 girls from two English-medium private schools in Kolkata, India. Survey participants were students in classrooms selected based on a convenience sample. The study sample was reduced to 373 after exclusion of missing responses for any one of the variables of interest (those relating to media use, socio-economic status, and adiposity). Table 4 shows the percentage of data missing from each variable of interest.

Table 4. Percentage of data missing from total sample (n=610)

Variable of interest	n missing (%)
Time spent watching television	4 (0.6)
Time spent watching movies	54 (8.9)
Time spent watching videos	50 (8.2)
Time spent reading magazines	26 (4.3)
Mother's highest level of educational attainment	49 (8.0)
Father's highest level of educational attainment	55 (9.0)
Computer in the home	15 (2.5)
Cell phone ownership	3 (0.5)
Body mass index (BMI) *	37 (6.1)

*height, weight, age required for BMI calculation

Measures and definitions

Body mass index and overweight/obese status (dependent variable)

Girls' height and weight were measured through self-report. Height and weight were used to calculate body mass index (BMI) [weight(kg)/height(m)^2]. Using internationally based cut-offs developed by Cole and colleagues (2000), the age- and sex-specific BMI cut-point for overweight passes through BMI of 25kg/m^2 at age 18, and for obese, through BMI of 30kg/m^2 at age 18. These cut-off points are presented in Table 5. Due to the exploratory nature of this study, and the small sample size of girls with excess weight, girls who were overweight and obese were combined and examined as a single group. In presentation and discussion of findings, this group is collectively referred to as overweight (vs. those who are not).

Table 5. Cut-off points for overweight and obesity among adolescent girls based on BMI as described by Cole et al. (2000)

Age (years)	Overweight	Obesity
12	21.68	26.67
13	22.58	27.76
14	23.34	28.57
15	23.94	29.11
16	24.37	29.43
17	24.70	29.69
18	25.00	30.00

Media use (independent variable)

Time spent watching/using media was assessed by the questions: "In a typical week, how much time do you spend....(a) watching TV (not videos), (b) watching videos, (c) watching movies (in theatre, not rented videos), (d) reading magazines (non-school related)?". Response categories for each of these questions were "0 hours" through to "more than 20 hours". A summary variable of time spent watching TV, movies, videos, and reading magazines per week was created by adding the responses to these four questions together. This summary variable is referred to as media use. A summary measure was not calculated for participants who were missing a response to one or more of the original questions (listed above), and these respondents were not included in the data analyses.

The summary variable for media use was used to create a two-category dichotomous variable: low use (≤ 7 hours/week) and high use (> 7 hours/week). The cut-point for the two categories was made at the 50th percentile of the distribution.

Socio-economic status (independent variable)

Given the challenge of measuring socio-economic status (SES) in adolescent populations, two proxy measures for adolescent SES were created: SES based on material possessions, and SES based on parents' highest level of educational attainment.

SES based on material possession

A proxy measure of affluence was developed based on cell phone ownership and the number of computers at home. Cell phone ownership was determined by asking participants about the amount of time they spend talking/text-messaging on their cell phones. Participants who did not own a cell phone were asked to check the box "I don't own a cell phone". The presence (and number) of computers in the home was assessed by the question: "Do you have a computer in your household? DO NOT include Nintendo/Playstations, or other computers than can only be used for games"; if participant selected "Yes" then they were asked to record the number of computers in the household.

Participants were placed in the higher material SES group if they owned a cell phone and had at least one computer in the home, or if they had more than 1 computer in the home, regardless of cell phone ownership. Participants were placed in the lower material SES group if they did not own a cell phone or computer, if they owned a cell phone but no computer, *or* if they had 1 computer but no cell phone.

SES based on parental highest level of educational attainment

The SES level of participants was also estimated using information about the educational background of their mother and father. In two separate scales, one pertaining to their father the other pertaining to their mother, participants were asked: "What is the highest level of education that your mother and father have completed? Please check ONE category per parent". The category options included: elementary school, some high school, high school, some university, university undergraduate degree, master's degree, medical degree, law degree, and Ph.D.

For both mother's and father's educational attainment, responses were divided into two categories ('higher', 'lower' educational attainment) using the distribution and making cut-points at the 50^{th} percentile. High educational attainment was classified as obtaining any university degree (undergraduate or post-graduate) and low educational attainment was used to categorize those without a university degree.

A three-category summary variable combining mother's and father's educational attainment was also created (Lower = where both mother's and father's educational attainment fell into the 'lower' category, Average = one parent in 'higher' category, one parent in 'lower' category, and Highest = both parents in the 'higher' category).

Statistical analysis

To determine the relationships and test the associations between overweight, SES, and media use, chi square tests were carried out. All variables were transformed into categorical variables. Logistic regression models were applied to assess the risk of overweight in relation to the analyzed variables. Odds ratios were also calculated with the non-overweight group serving as the reference group.

All statistical analyses were performed using SAS (version 9.1). Statistical significance was set at $P < 0.05$.

RESULTS

Descriptive statistics

In total, data from 373 participants were analyzed. Table 6 presents a selection of demographic, behavioural, and health characteristics of the sample.

On average, media use among adolescent girls averaged 9.82 hours per week when television, video, movie, and magazine use were combined. Adolescent girls in this sample spent the most time watching television (4.4 hours/week on average) followed by movies (2.78 hours/week on average). As proxy measures used to estimate SES, over three-quarters of adolescents sampled had at least one computer in their home, and about 50% had their own cell phone. Parents of the participants in this study ranged in education level; in general, compared to mothers, fathers demonstrated a higher level of educational attainment. High school was the highest level of educational attainment for approximately 38% of mothers (compared to 25% of fathers). Almost half of fathers (45%) possessed a post-graduate degree while only 28% of mothers completed post-graduate studies.

Participants ranged from 12 to 18 in age (grades 7 to 12), with a sample mean of 14.4 years. Approximately 13% of the sample was overweight. Table 7 demonstrates the prevalence of overweight by age group. The highest rate of overweight was observed in the youngest age group where 17.5% of 12-13 year olds were overweight.

Table 6. Selected socio-demographic, health and behavioural characteristics of study participants

Demographic characteristics	**N**	**Mean**	**Std. Dev.**
Age (years)	373	14.6	1.58
Media Use	N	Mean	Std. Dev.
Time spent watching movies (hours/week)	373	2.78	2.65
Time spent watching videos (hours/week)	373	1.64	2.87
Time spent watching television (hours/week)	373	4.40	4.83
Time spent reading magazines (hours/week)	373	1.00	1.43
Overall time spent with media sources (hours/week)	373	9.82	8.65
Weight classification	**N**	**Percentage**	
Underweight or Healthy Weight	324	86.86	
Overweight or Obese	49	13.14	
Proxy measures for socio-economic status	**N**	**Percentage**	
Number of computers in household			
None	89	23.86	
1	187	50.13	
More than 2	97	26.01	
Owns a cell phone	195	52.28	
Father's Highest Level of Educational Attainment			
0: Elementary, some High school, or High school diploma	92	24.66	
1: Some University or University undergraduate degree	115	30.83	
2: Post-graduate degree (Masters, Doctorate, Medical, Law)	166	44.50	
Mother's Highest Level of Educational Attainment			
0: Elementary, some High school, or High school diploma	142	38.07	
1: Some University or University undergraduate degree	128	34.32	
2: Post-graduate degree (Masters, Doctorate, Medical, Law)	103	27.61	

Table 7. The prevalence of overweight based on age- and sex-specific BMI measures

Age (years)	Total surveyed (N overweight)	Percent overweight
12 - 13	103 (18)	17.47
14 - 15	144 (15)	10.42
16 -18	126 (16)	12.70
All combined	373 (49)	13.14

Cross-sectional associations

Prevalence of overweight by proxy measures of socio-economic status

The prevalence of overweight adolescent girls was greater among those of higher socio-economic status. Table 8 shows the association between overweight and various proxy measures of SES.

Table 8. Measures of socio-economic status and the prevalence of overweight

Independent Variable & Sub-variable	Percent of entire sample	Percent overweight	DF	Chi-Square (p value)
Material SES score ‡				
Low	49.6	10.81	1	0.1871
High	50.4	15.43		
Computer in Home?				
No	23.86	5.62	1	0.0161*
Yes (at least one)	76.14	15.49		
Mother's Level of Educational Attainment				
Low (no University degree)	57.10	9.39	1	0.0134*
High (any University degree)	42.90	18.13		
Father's Level of Educational Attainment				
Low (no University degree)	45.58	6.47	1	0.0005*
High (any University degree_	54.42	18.72		
Composite SES score (parents' educational attainment combined)				
Low (both parents 'low')	42.36	6.96	2	0.0048*
Average (one parent 'low', other 'high')	17.96	13.43		
High (both parents 'high')	39.68	19.59		

‡ Material SES score based on cell phone and computer ownership (Low = no computer and no cell phone, OR 1 computer, no cell phone, OR no computer, a cell phone; High = computer AND cell phone, OR more than 1 computer regardless of cell phone ownership)

* denotes significant association (p < 0.05)

The prevalence of overweight among adolescent girls with a high material SES score was greater than those with fewer material assets; however, the association between body weight and material assets was not significant. When cell phone ownership was excluded and computer ownership alone considered, adolescents with a computer in their home demonstrated a greater prevalence of overweight (15.49%) than those without (5.62%), and the relationship between household computer ownership and overweight was significant (χ^2=5.79, p=0.0161).

When parents' educational attainment was used as a proxy for adolescent SES, a significant association between overweight and SES was demonstrated. Overweight was significantly higher among girls whose mothers had a high level of educational attainment (18.13%) compared to those with mothers with less education (9.39%) (χ^2=6.12, p=0.0134). A similar relationship was demonstrated with fathers' highest level of educational attainment - the prevalence of overweight was greater for adolescents with highly educated fathers (18.72% versus 6.47%; χ^2=12.16, p=0.0005). When the educational level of both parents was combined, overweight among adolescent girls increased with increases in parental educational attainment, and the relationship was significant (χ^2=10.69; p=0.0048).

Prevalence of overweight by media use

As demonstrated in Table 9, the relationship between overweight and media use in Kolkata girls is complex.

Table 9. Measures of media use and the prevalence of overweight

Variable & Sub-variable	Percent of entire sample	Percent overweight	DF	Chi-Sq. (p value)
Media use (TV, movies, videos, magazines combined)				
Low (< 7 hours/week)	50.67	11.11	1	0.2405
High (> 7.5 hours/week)	49.33	15.22		
Media use (TV, movies, videos, magazines combined)				
Low (0 - 5.5 hours/week)	35.66	14.29	2	0.0780
Average (6 - 9.5 hours/week)	24.49	7.27		
High (> 10 hours/week)	34.85	16.92		

A greater proportion of girls were found to be overweight in the high media use group (15.22%) as compared to girls in the low media use group (11.11%), however, the association was not statistically significant (χ^2=1.38, p=0.2405). When media use was categorized as high, average, and low, there was no clear pattern with overweight status and the chi-square test were not significant (χ^2=5.10, p=0.078).

The relationship between media use and SES

The relationship between media use and several proxy measures of SES is presented in Table 10.

Table 10. Measures of socio-economic status and the prevalence of high and low media use overweight

Variable & Sub-variable	Percent Low media users (<7hrs./wk)	Percent High media users (>7.5 hrs./wk)	DF	Chi-Sq. (p value)
Material SES score ‡				
Low	55.68	44.32	1	0.0551
High	45.74	54.26		
Computer in Home?				
No	65.17	34.83	1	0.0017*
Yes (at least one)	46.13	53.87		
Mother's Level of Educational Attainment				
Low (no University degree)	57.28	42.72	1	0.0032*
High (any University degree)	41.88	58.13		
Father's Level of Educational Attainment				
Low (no University degree)	57.06	42.94	1	0.0239*
High (any University degree)	45.32	54.68		

‡ Material SES score based on cell phone and computer ownership (Low = no computer and no cell phone, OR 1 computer, no cell phone, OR no computer, a cell phone; High = computer AND cell phone, OR more than 1 computer regardless of cell phone ownership)

* denotes significant association ($p < 0.05$)

There was a significant association between media use and SES measures using parental educational attainment as proxies (Mother: χ^2=8.67, p=0.0032, Father: χ^2=5.10, p=0.0239). In addition, there was a meaningful relationship between media use and the presence of a computer in the home (χ^2=9.83, p=0.0017). The overall material SES score (with cell phone ownership included) was not significantly related to media use.

Logistic regression analyses

Given the significant associations demonstrated through chi-square testing, further analysis focused on overweight cases in an effort to assess the correlation (strength of relationship) between overweight and various measures of socio-economic status. A model was also developed to assess the relationship between media use and overweight, when controlled for SES.

Table 11. Results from logistic regression with overweight status as dependent variable and measures of SES and media use as independent variables

Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Computer in home	1.125 (0.487)**					
Own cell phone		-0.058 (0.307)NS				
Mother's highest level of educational attainment			0.759 (0.312)*			
Father's highest level of educational attainment				1.203 (0.360)***		1.175 (0.362)**
Media Use					0.362 (0.309)NS	0.247 (0.316) NS
Intercept	-2.821	-1.859	-2.267	-2.6709	-2.079	-2.783
Likelihood ratio (p-value)‡	0.009	0.850	0.014	0.0003	0.240	0.0011

Data presented as B(SE); where B=coefficient estimate, and SE=standard error
NS = not significant, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$
‡Likelihood ratio (p-value) = significance of model

As demonstrated in Table 11, overweight was positively correlated with three of the four proxy measures for socio-economic status: computer in the home, level of educational attainment by mother, and level of educational attainment by father. Overweight and cell phone ownership were not significantly correlated in this sample.

Chi square analysis (Table 9) did not show overweight status to be significantly related to media use, nor was a significant correlation found in regression modelling where media use served as the only independent variable (Table 11, Model 5). However, because media use was significantly related to various proxy measures of SES (Table 10), a model was created to explore the strength of association between media use and overweight status when controlled for SES (Table 11, Model 6). Fathers' level of educational attainment was selected as the proxy SES variable to control for in Model 6 because compared to other SES proxy variables, it showed the strongest association with overweight status in this sample. As Model 6 demonstrates, when controlled for SES, the association between media use and overweight remained insignificant.

SES alone is a strong predictor of overweight in adolescent girls in this sample. Father's level of educational attainment was the single best predictor of overweight status (Model 4, p=0.0003), followed by computer in the home (Model 1, p=0.009) and mothers' level of educational attainment (Model 3, p=0.014). Overall, these logistic regression results suggest that there is something else about SES (not necessarily media use as it is defined here) that is contributing to the weight status of adolescent girls in this study.

Recognizing the strength of SES in predicting overweight, odds ratios presented in Table 12 demonstrate the estimated odds that an overweight girl experienced a particular condition related to SES.

Table 12. Odds of being overweight in relation to selected proxy measures for socio-economic status

Factor	Category	Odds Ratio†	95% CI	Likelihood ratio p-value
Computer in home	No Yes	1.0 3.079	1.182- 8.022	0.009*
Mother's Level of Educational Attainment	Low (no University degree) High (any University degree)	1. 0 2.136	1.159-3.937	0.014*
Father's Level of Educational Attainment	Low (no University degree) High (any University degree)	1.0 3.329	1.644-6.740	0.0003*

† where odds ratio=1.0, denotes reference group
* denotes statistically significant ($p < 0.05$)

Compared to non-overweight girls, overweight girls had three times greater odds of having a computer in the home (OR=3.079). Overweight girls also had significantly greater odds of having highly educated parents. The odds that an overweight girl had a mother with a university degree was two times the odds that a non-overweight girl had a mother with a university degree (OR=2.136). Similarly, overweight girls had three times greater odds of having a father with a university degree compared to non-overweight girls (OR=3.329).

DISCUSSION

Chhatwal and colleagues (2004) found that among preadolescents and adolescents (aged 9-15) in Ludhiana, India, the prevalence of obesity was directly proportional to SES; that is, obesity rates increased as SES increased. A relationship between SES and overweight was also observed in this study – significantly more girls in the higher SES group were overweight compared to the lower SES group. This finding is similar to earlier studies on urban adolescent populations in India (Laxmaiah et al., 2007a; Kaur et al., 2005).

Overall, adolescent SES (as measured by parents' educational attainment or computer presence in home) appears to be a good predictor of overweight. Both fathers' and mothers' highest level of educational attainment were significantly correlated with the weight status of their adolescent daughters, and fathers' educational status demonstrated a particularly strong correlation. This finding supports a recent study by Baharti and others (2007) which looked at the relationship between energy deficiency and obesity, and SES in adult women. The authors found that a woman's occupation and education has the most influence on the well-being of the family members, as well as on her own health status (Baharti et al., 2007).

The association between SES (as measured by parental educational attainment) and overweight can be explained, in part, by the luxuries wealth and status offer. Higher educational attainment often results in higher paying occupations, and thus, higher income levels overall. In India, higher SES families can afford to purchase greater quantities of food, as well as foods that are more expensive (and usually higher in fat and sugar). Data shows that higher-income groups consume a diet containing 32% of energy from fat, compared with 17% in lower-income groups (Shetty, 2002). A study of adolescents aged 12-15 in Hyderabad, India, also reported that compared to lower SES groups, the diets of youth in higher SES groups had greater fat content (Laxmaiah et al., 2007b). A study using data from India's National Family Health Survey reported on the relationship between SES and health outcomes of adult women, and found that the standard of living index (which is directly related to the amount of disposable income available for food) was the single measure most strongly associated with under- and over-nutrition (Subramanian & Smith, 2006). The authors suggest that higher expenditure on food is related to overweight/obesity.

The consumption of unhealthy food may also be related to the decision-making and purchasing power of high SES adolescents in this population. Both in and outside of the home, adolescents of high SES have a say in what they eat. For example, affluent teens in Kolkata have greater access and more opportunities to attend movies and social clubs, and spent their free time in malls. In these environments, the majority of options are fast food and fried snacks, and the adolescent makes a personal choice about what to eat. Future studies should explore the food choices adolescents make as they develop and gain greater independence outside the home.

The central tenet of overweight/obesity posits that energy in must not exceed energy out. In addition to examining the relationship between SES, nutrition/diet, and adolescent overweight, analyses must also explore the impact of physical activity on weight status. SES is also likely to be associated with energy expenditure and sedentary behaviour in this adolescent population, and this requires further investigation.

A recent study by Laxmaiah and colleagues (2007a) reported that youth in higher SES groups were more sedentary than those of lower SES. Adolescents from high SES families may enjoy greater access to transit, for example, being driven to school instead of walking. The lives of girls in higher SES groups may also be less labour intensive lives overall with greater access to technology and labour-saving devices (e.g. dishwashers, washing machines). Further, it is unlikely that high SES girls in Kolkata participate in any chores in the home since affluent families often hire outside workers to assist in housework.

In addition to offering more opportunities for vehicular transportation, living in an urban centre may also present several barriers to physical activity in youth and adolescents. It is possible that physical activity is restricted in certain urban environments due to air pollution, traffic, and other safety issues, some of which may be augmented for girls. Further analyses need to look at the physical activity patterns of girls in urban centres to understand the environmental barriers to exercise.

In this study, the prevalence of overweight was not significantly related to the material SES measure that combined cell phone ownership and computer presence in the home. However, when these variables were explored separately, overweight was strongly correlated with computer presence in the home. This finding is similar to a study on Finnish teens where having a home computer was associated with a higher risk of overweight and a larger BMI, and cell phone use was correlated weakly with BMI (Lajunen et al., 2007). This study did not analyze time spent using a computer, which may be helpful in elucidating how computer presence in the home is related to overweight. It is probable that computer ownership is related to sedentary activity as well as to SES.

In this study, the youngest age group (those aged 12-13) demonstrated the highest prevalence of overweight. This finding supports research showing a growing epidemic of childhood obesity in India, especially among more affluent groups (Kelishadi, 2007; Wang & Lobstein, 2006). Greater prevalence of overweight in younger adolescent girls may also be related to puberty onset, which often results in body composition changes and a substantial amount of weight gain.

In addition to growth in childhood obesity prevalence rates, there are several other explanations for the difference in the prevalence of obesity between older and younger adolescent age groups. Particularly for older adolescent girls, body weight is, in part, the result of a pattern of behaviours that directly and indirectly stem from the socio-economic and cultural context within which the lives of women/girls are embedded. In Western cultures, a great deal of research has explored the social construction of gender where girls/women are socialized into a society that devalues women's bodies, roles, and social positions, especially during adolescence (Hesse-Biber et al., 2006; Hood, 2005). In this affluent, urban, and increasingly Westernized Indian population of adolescent girls, it is possible that similar ideals and pressures have penetrated, and further research examining this possibility is needed.

Exploring how physical activity patterns of girls in India are shaped by gender and culture is also important for obesity prevention. Expectations regarding body shape and physical activity participation may be different between girls and boys, and between different SES groups. For example, consideration should be given to the time of day/night when adolescent girls are engaged in sedentary activity, including media use and other screen time activities (Bryant et al., 2007). If the majority of sedentary activity occurs in the evening, and this is a time when physical/social activities are restricted for adolescent girls in this population, prevention activities targeting physical activity must consider this.

Ramachandran (2004) notes that with lifestyle changes occurring in India, there is more mental stress associated with modernization. Additional analyses of this pilot study should examine whether there is a relationship between mental health issues (e.g. stress, depression), SES and weight status in adolescent girls. This type of exploration would also address questions about the prevalence of eating disorders and dieting behaviours in Indian adolescents.

Study limitations

One of the limitations of this study was the focus on a very select population: affluent girls from two English-medium private schools in Kolkata, India. The cross-sectional nature of this study also prevents the identification of any causal relationships.

Obesity status in this study was determined based on internationally developed sex- and age-specific BMI cut-offs. BMI as a measure of adiposity is problematic because it relies solely on measures of height and weight. BMI does not distinguish fat mass from lean muscle mass, nor does it describe the distribution of adiposity. Recognizing the danger of visceral/central obesity, other measures of fatness are more accurate (e.g. waist circumference, skinfold measures, and/or waist-to-hip ratios, and dual-energy x-ray absorptiometry). For adolescent girls in particular, BMI may not be the most accurate measure of body fatness since their bodies undergo rapid change during puberty.

Another issue with BMI relates directly to cut-off points for classifying overweight and obesity. As described, BMI cut points for youth and adolescents populations are age- and sex-specific; however, these values derive from cut-points established for adults over 18 years of age. Some research suggests that adult cut-points for obesity and overweight should be adjusted for certain populations, including South Asians (of which India is part). Singh and colleagues (2007b) argue that in South Asian adult populations a BMI of 25 kg/m^2 and above should be classified as obese. A BMI of 23 kg/m^2 and above should be considered overweight and at a risk for obesity (versus the current cut-point of 25-29.9 kg/m^2 for overweight, and above 30 kg/m^2 for obese). South Asians have smaller body frames and are more susceptible to central obesity (Singh et al., 2007b). South Asians' vulnerability to diabetes also supports this BMI reclassification, in South Asians, the risk of metabolic syndrome increases when BMI is 23 kg/m^2 and above (Singh et al., 2001). Coronary risk factors also appear to increase above a BMI of 23 kg/m^2 (Indian Consensus Group, 1996, as cited in Singh et al., 2007b; Ramachandran, 2004). The WHO supports this category adjustment and have recommended similar modifications to BMI classifications in other populations (WHO Regional Office for the Western Pacific, 2000; WHO, 2004). It is unclear whether a similar change to BMI measures is warranted for youth/adolescent South Asian populations; if so, the prevalence of overweight in this study is likely an underestimation.

Overweight/obesity status (classified by BMI) may also be underestimated when body mass and/or height values are inaccurate. This study used self-report measures of height and weight, which presents limitations, particularly in studies involving adolescents. Studies show that adolescents tend to overestimate height, and underestimate weight (Fortenberry, 1992; Elgar et al., 2005). Reporting errors for weight are of even greater concern in heavier teens, who tend to underreport their weight by significantly more than adolescents in lighter weight categories (Fortenberry, 1992). Other studies report similar findings, but endorse the use of self-report measures of height and weight over self- or parental-report of obese/overweight status – which were poor predictors of actual obesity (Goodman et al., 2000; Brener et al., 2003). Although adolescent self-reports may not be entirely accurate, research suggests that the magnitude of such inaccuracy is not likely to have a significant effect overall, but should be acknowledged as a potential bias (Fortenberry, 1992; Strauss, 1999). Future studies on this population of adolescent girls should validate self-reported measures by having a researcher objectively measure girls' height and weight. Despite these shortcomings, BMI is a useful and widely employed measure of overweight/obesity status. BMI was used in this study because it is more cost effective than other measures of adiposity, easy to calculate, standardized for age and sex, and has developed cut-points for international use (Cole et al., 2000).

The media use variable created for this analysis was also somewhat problematic, and may help to explain why media use was not significantly associated with obesity in this study. The assumption is that media use is a sedentary activity, and that inactivity contributes to obesity. It is problematic to assume that all screen time/media use activities are sedentary, and exploring whether this assumption is true is important in future studies. In addition, the media use variable did not represent the full range of sedentary activity. Media use in this study only captured time spent watching television, movies, videos, and reading magazines. Missing responses prevented analysis of other screen time variables including time spent using videogames, computer/internet, and reading/studying. Transportation is also important to physical activity levels and sedentary behaviour. The survey did not ask questions relating to forms of transportation used or time spent in transit.

Proxy measures used for SES are not perfect, and there is no consensus on which measures best estimate SES in adolescent populations (Boyce et al., 2006; Currie et al., 1997). It is difficult to accurately assess SES levels of adolescents, especially when information is self-reported. Classification of adolescent SES would have ideally been based on family income, however, this was not possible because parents were not surveyed, and adolescents are not often aware of their total family income/assets (Currie et al., 1997). Parental educational attainment and ownership of material goods were used as proxy measures, but may not be entirely representative of family SES or of an individual adolescents' SES.

Cell phone ownership was not a meaningful measure of SES for adolescents residing in urban centres in India because they are highly affordable. If desired, many people residing in an urban setting in India can afford a cell phone. In this study, it is possible that cultural/family values/opinions, not expense, prevented some adolescent girls from owning cell phones. The inclusion of cell phone ownership in measures of material SES may have introduced misclassification in this study.

Material SES measures can be improved in future studies through the addition of other variables. Family ownership of computers is one only variable used in the Family Affluence Scale (FAS), an objective measure of wealth that is validated for use in studies focusing on the relationships between SES and youth and adolescent health (Boyce et al., 2006). Future studies should include other variables used in the FAS, such as family vehicle ownership, number of household bedrooms, and family holiday/travel opportunities.

Final thoughts

As discussed, several immediate next steps can be taken to gain a better understanding of the relationship between obesity and SES in this affluent population of adolescent females in India. Exploring the impact of diet and physical activity/sedentary behaviour on overweight status in this population of adolescent girls should be a priority to help elucidate the correlation between SES and body weight.

As Caballero (2005) explains, in developing countries, wealthier segments of the population have the potential to combat obesity because they have "access to better education about health and nutrition, sufficient income to purchase healthier foods (which are usually more expensive), greater quantities of leisure time for physical activity, and better access to health care" (Caballero, 2005). Educated people within high SES groups are also the first to respond to nutrition education messages and reduce their risk of obesity (Monteiro et al., 2001, as cited in Griffiths & Bentley, 2001). These are important and promising points to note considering the finding that teens of higher SES are more likely to be overweight.

However, public health experts know that education is not enough. A recent study in Bangalore, India found that knowledge of unhealthy foods was greater in high SES women compared to women of lower SES, yet the high SES women had poorer diets and lower activity levels (Griffiths & Bentley, 2005). Knowledge alone is not the solution; there is a need for healthy public policy and prevention programs, and these are best directed toward children, youth, and adolescent populations. It is far cheaper to target children and youth through primary and secondary prevention than to provide adults with tertiary prevention/treatment measures later in life.

Research from developed and developing countries suggest that prevention efforts are promising when they involve healthy public policy and environmental intervention. Improving the "obesogenic" environment in developed countries is proving to be difficult, and improving/preventing the obesogenic environment in developing nations is even more challenging. Governments and non-governmental organizations have an important role to play in protecting and promoting a healthy and supportive environment. Strategies/actions may include, but should not be limited to: monitoring the food market and the way foods are produced, supporting community-based initiatives promoting physical activity and healthy eating, changing the way urban centres are planned and designed, encouraging active transportation, and improving public safety. Marketing campaigns may also be useful in obesity prevention by helping to increase awareness, enhance understanding, and encourage the adoption of healthy behaviours.

Specific to adolescent populations in urban centres in India, there is a need to target interventions using mediums attractive to adolescents (e.g. television, internet, print media, cell phones etc.). As mentioned, the adolescent girls in this study are from higher echelons in Kolkata, and many enjoy an increasingly Westernized lifestyle. It is important to ensure obesity prevention efforts and health promotion efforts are designed with their socio-economic context and social realities in mind. Lastly, because overweight in children, youth and adolescents in India is occurring simultaneously with malnutrition and underweight, it is important that obesity prevention strategies occur alongside efforts to address other nutrition problems in young populations.

CONCLUSION

This study confirms that SES is a good predictor of weight status in adolescent girls attending English medium schools in Kolkata, India. Specifically, parents' level of educational attainment and computer presence in the home were associated with overweight. Media use does not appear to be related to weight status in this sample; however, given that media use constitutes only a portion of sedentary behaviour, additional analysis on inactivity and physical activity patterns is required. The key to prevention of any disease or chronic condition relies on identification of modifiable risk factors. Future research should expand the findings of this study and explore what specific aspects of SES are related to overweight. In addition to differences in physical activity, it is possible that diet and eating patterns explain some of the difference in overweight prevalence observed between adolescent girls of higher and lower SES.

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