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Association of Body Mass Index between Adolescents and their Parents in Mumbai and Kolkata: A Population-based Study

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Abstract

Introduction: Adolescent overweight and obesity as measured by body mass index (BMI) seem to be increasing at an alarming rate in urban populations. Parental BMI plays an important role in their adolescent's BMI. Overweight and obesity coexisting with undernutrition in adolescents is an important public health challenge in low- and middle-income countries (LMICs). We present results from a population-based study on adolescents' prevalence of BMI and its association with their parents' BMI in Mumbai and Kolkata, India.

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Conflict of interest:

Dr Prakash C Gupta is associated as the Editorial Board member of this journal and this manuscript was subjected to this journal's standard review procedures, with this peer review handled independently of this editorial board member and his research group.

Ethical Approval

The study is approved by the Institutional Review Boards of the Healis Sekhsaria Institute for Public Health(2015/18/03) and the University of Michigan University (HUM00129316) and parental/guardian permission was obtained for minor participants (under 18 years of age), who were asked to provide assent prior to enrollment in the study. Any protocol changes will be reported immediately to each Institutional Review Board.

Methods and materials: Multistage random sampling of households was used to select adolescents aged 12–14 years and one of their parents in 2019–2020. In Mumbai, 843 adolescents, and in Kolkata, 913 adolescents and one of their parents were interviewed independently by trained field investigators. Height and weight were measured using standardized procedures. Adolescents' BMI categories were defined using Centers for Disease Control and Prevention (CDC) recommendations. For parents, the BMI was categorized using Asian cut-off categories into underweight (BMI < 18.5), normal weight (BMI: 18.5–22.9), overweight (BMI: 23.0–27.0), and obese (BMI > 27.0). Multivariate logistic regression was used to determine the relationship between parental BMI and adolescents' BMI.

Results: In Mumbai, 15.7% and in Kolkata, 21.1% of adolescents were overweight or obese. Nearly 80% of mothers and 70% of other parents were either overweight or obese. The mothers of adolescents who were overweight or obese showed a high risk of their adolescent being overweight [odds ratio (OR): 4.16 (1.36–12.73)] or obese [OR: 18.53 (2.02–170.44)] in Mumbai and [OR: 4.45 (1.25–15.80)] and [OR: 8.81 (1.40–55.33)] in Kolkata respectively after adjusting for adolescent's gender and head of the household's highest level of educational attainment.

Conclusion: Adolescents' overweight/obesity status is strongly associated with their mothers' BMI in urban India. This association may reflect both genetic and environmental effects. The present study highlights the high prevalence of adolescent overweight and obesity in these urban populations and underscores how important it is to identify effective public health strategies for the primary prevention of childhood obesity.

Keywords

Adolescents; Body mass index; Loneliness; Obesity

Introduction

In many low- and middle-income countries (LMICs), the prevalence of overweight and obesity is increasing and emerging as a public health risk.[1,2] The increasing prevalence of overweight and obesity coexisting with undernutrition is an increasingly significant public health challenge in LMICs, especially in women with lower levels of attained education.[3,4] On one hand, improved economic conditions, urbanization, the prevalence of sedentary routines, and dietary changes such as reduced dietary diversity have caused a steady increase in overweight and obesity. On the other hand, many LMICs are continuing to face concurrent challenges posed by undernutrition and its consequences.[5–8] The overweight and obesity prevalence has doubled and tripled in preschool and primary school-aged children, respectively, in India.[9]

Numerous earlier studies have shown that overweight and obesity in adolescent are the intricate interaction between genetic and environmental factors.[10–12] Parental weight status has been shown to be an important predictor of their children's obesity risk.[13] Adolescents whose parents had a normal body mass index (BMI) exhibited healthier behaviors such as regular physical activity and healthy eating patterns compared with adolescents whose parents were overweight or obese.[14]

Preventing childhood obesity is a public health priority, because childhood obesity increases risk of obesity in adulthood and is associated with long-term adverse health consequences, both physical and emotional, such as loneliness.[15–18] The onset of childhood obesity and its persistence into adulthood cannot be entirely attributed to inherited traits, but also to parental health practices.[11,19] Many studies have examined the relationship between the severity of obesity in parents and their children in various age groups.[20–24]

In this paper, we report the results of these associations using data from a population-based study of adolescents and their parents in Mumbai and Kolkata, India.[25] The purpose of this paper is to examine how the BMI status of 12–14-year-old adolescents relates to the BMI status of their parents, taking into account other confounding factors.

Methods and Materials

Sampling Design

We selected two cities Mumbai, Maharashtra and Kolkata, West Bengal as two large, populous, geographically distant and culturally diverse urban areas. To obtain a representative sample of communities and adolescents in both cities, we used a multistage sampling design. We used a sampling frame obtained for urban areas from the National Sample Survey Organization (NSSO) of the Ministry of Statistics and Program Implementation known as the Urban Frame Survey.[26] The geographic areas in the sampling frame were hierarchically nested as states, cities, investigator units (IV units) and blocks. Most blocks were designated by the NSSO as affluent residential areas, residential areas, and slum areas.

Sampling Plan

We sampled 26 IV units in each city from 916 IVs in Mumbai and 333 in Kolkata followed by 5 blocks on an average per IV unit for a total of 272 blocks out of total 27,059 from both cities. All the households within the selected blocks were enumerated and eligible households were recruited in the study. Households having at least one adolescent aged 12–14 years living with his/her parent were eligible for the study. During 2019–2020, a total of 843 adolescents in Mumbai and 913 in Kolkata eligible adolescents 12–14 years of age and their parent were surveyed. The measures of height and weight were obtained using scientific and uniform procedures as discussed in the following subsections:

Weight Measurement

A bathroom scale accurate to 0.1 kg (CAS Weighing Scale – HE23) was used to measure the weight of the study participants. The scale was placed on a flat, hard surface (not on a carpet). Participants were requested to step on the weighing scale with bare feet with hands by their sides, immobile without leaning on furniture or holding on to anything. Respondents' weight measurements were recorded after ensuring removal of heavy clothing such as coats, jackets and vests, purses, cell phones, keys and heavy accessories such as belts with heavy buckles. A zero reading on the weighing scale was obtained prior to each use of the scale. Respondents were asked to stand motionless in the center of the scale platform with feet slightly apart and body weight distributed equally on both feet. Respondents were

then asked to step down from the scale and the displayed weight was recorded to the nearest 0.1 kg. Two measures per respondent were recorded for reliability; if the discrepancy between these first two measures was greater than 0.1 kg, then a third measure was taken and the average across all three measures was used as final measurement.

Height Measurement

The height of the respondents was measured using a portable stadiometer. Respondents were asked to remove their shoes, hats and any other hair accessories. Participants were asked to stand erect, back touching to the wall, with feet together, arms at sides, legs straight, and shoulders relaxed. Each respondent's heels, buttocks, and shoulder blades and head were maintained in contact with the wall. A ruler was touched to the crown of the head, compressing the hair, if necessary. Respondents were asked to step out so that the interviewer could get closer to the ruler scale and take the reading. The ruler scale wasn't moved until the height measurement was recorded. Height was recorded to the nearest centimeter. Two measures were recorded for accuracy; if discrepancy between those measures was greater than 1 cm, then a third measure was taken and the average across all three measures was used as a final measurement.

The structured questionnaire for data collection was made retrievable online using REDCap software.[27,28] All data collected during face-to-face interviews were entered directly in computer tablets in the field and daily transferred to a secured server. The BMI values for each adolescent and their parent were calculated by using the formula "Weight (kg)/[height (m)]^2." Asian cut-off values for adults were used to categorize them into underweight (BMI: <18.5); normal weight (BMI: 18.5–22.9); overweight (BMI: 23.0–27.0); and obese (BMI > 27.0).[29] The BMI categories for adolescents were defined using the following Centers for Disease Control and Preve (CDC) recommendations: Underweight: Less than the 5th percentile; Normal weight: From 5th percentile to less than the 85th percentile; Overweight: From 85th percentile to less than the 95th percentile; Obese: From 95th percentile or greater.[30] To assess loneliness among adolescents, the following question was used: "During the past 30 days, how often have you felt lonely?" Response options were as follows: "Never," "Sometimes," "Most of the times," and "Always." For analysis purposes "Sometimes," "Most of the times," and "Always" were coded as "Yes" and "never" as "No."

Analysis

Descriptive statistics were calculated for both cities separately. All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS), version 20.0, software using the complex sample survey analysis programs and project sampling weights. Multivariate logistic regression was used to evaluate the relationship between parental BMI and each adolescent's BMI. Adolescent's gender and head of the household's highest level of education were included as covariates. he outcome variable BMI of the adolescents in relation to parental underweight, overweight or obese status, with parental normal weight status serving as the reference. Odds ratios (ORs) along with [95% conference intervals (CIs)] were calculated.

Results

Table 1 describes the sample characteristics of Mumbai and Kolkata, respectively. Around 80% of mothers and 70% of other parents in Mumbai and Kolkata were overweight or obese. About 5% in Mumbai and 4% in Kolkata mothers were found to be underweight and other parents. Among adolescents, about 11.2% in Mumbai and 7.5% in Kolkata were overweight or obese. In both cities, around 5% adolescents were underweighted. Nearly 15.0% of adolescents in both cities reported that they often felt lonely in the past 30 days.

Table 2 describes the adjusted odds ratios for the association of adolescents' BMI with their parents' BMI, adjusted for gender and head of the household's highest level of education for Mumbai and Kolkata, respectively. Mother's underweight was associated with adolescent's overweight in Mumbai (Mumbai: 3.65, CL: 1.53–8.73) but no association was found in Kolkata. Mother's overweight and obesity status was positively associated with adolescent's overweight and obesity status in both cities (overweight: Mumbai: 4.16, CL: 1.36–12.73, Kolkata: 4.45, CL: 1.25–15.08; obesity: Mumbai: 18.53, CL: 2.02–170.44, Kolkata: 8.81, CL: 1.40–55.33). As compared to adolescent females, adolescent males were more likely to be obese (Mumbai: 2.79, CL: 1.02–7.58). Furthermore, those adolescents who often felt lonely in the past 30 days were more likely to be obese (Mumbai: 2.91, CL: 1.28–6.63, Kolkata: 2.90, CL: 1.61–5.21).

Discussion

The current study explored the associations of BMI status from Mumbai and Kolkata adolescents and their parents at the city level. Households of overweight parents are more likely to feature unhealthy dietary habits, leading to further issues and a sedentary lifestyle.[11,31] Therefore, it is important for parents with overweight to address their own weight issues and be mindful of the potential impacts that it could have on their children.[32] Furthermore, the parents' obesity can also create a home atmosphere that is not conducive to healthy eating habits or physical activity, leading to their child's unhealthy weight status.[24] Many parents and their adolescents can benefit from health interventions that focus on promoting healthier eating habits and physical activity.[33] Additionally, parents should be aware of the connection between weight status and health outcomes so they can be proactive in promoting healthy habits in their adolescents.[30]

Parents with overweight have been linked to having adolescents who are overweight. Many studies suggest that there is a strong association between parental and adolescent obesity.[24,34] In our study we found that adolescents from households with parents (mostly mothers) who were overweight or obese were at a significantly higher risk of overweight and obesity compared to adolescents of parents with normal weight. This is believed may be due to a combination of genetic, environmental and behavioral factors that influence both parents and adolescents and decreased physical activity and unhealthy eating patterns being passed down from one generation to the next.[13,35,36]

It is clear that the lifestyle of a mother with overweight can have significant consequences for her children's health and well-being. Several environmental factors, that is, parental

obesity, shared family lifestyle, food habits or socioeconomic status could explain the association between parent and child obesity risk.[37–40] More specifically, unhealthy parental eating habits, such as consuming more fried, fast food, and sweets, as well as a sedentary lifestyle, such as doing little exercise and spending too much time in front of the TV or using a computer, mobile phones may raise the risk of overweight and obesity in both parents and their children.[35,40]

The relationship between adolescent loneliness and obesity status is probably bidirectional.[41,42] While loneliness and social isolation can have numerous negative effects on mental health, they can also lead to adolescent overweight.[43,44] When adolescents feel lonely or socially isolated, they may turn to food as a means of comfort, leading to overeating and unhealthy weight gain.[45] Additionally, obesity-related stigma may make them less likely to engage in social or physical activities with others, further contributing to weight gain. Also, inn our present study, it has been reported that adolescents who felt lonely were found to be overweight or obese (obese – Mumbai, 2.91, CL: 1.28–6.63; overweight – Kolkata, 2.90, CL: 1.61–5.21). It is important for adolescents to have supportive social networks and to engage in healthy behaviors to maintain a healthy weight and optimize their overall well-being.[46] Encouraging adolescents to participate in group activities, to seek social support from family and friends, and eat a balanced and nutritious diet can all be helpful strategies for combating loneliness and preventing unhealthy weight gain.

Strengths and Limitations

The strengths of this study include the fact that we obtained a representative multistage sample of communities and adolescents in both major Indian cities, which will enhance generalizability. Given the nature of the study design being cross-sectional, causal association could not be ascertained. Thus, the association between parent BMI and the adolescents' weight remains to be confirmed in prospective studies. The head of the household's highest level of education was used as a proxy measure to control for household variation in socioeconomic status.

Conclusion

The prevalence of overweight/obesity is increasing in urban India among adults and adolescents. For optimal impact, lifestyle change efforts to reduce population obesity risk should be family-centered. More specifically, interventions for the prevention and control of childhood obesity should focus on changing the health behaviors of both parents and children.[47] Additionally, a more comprehensive intervention should include family environment as a multi-factorial contributing factor to childhood obesity epidemic. For these reasons, more studies need to be conducted using the most current data to confirm and extend the results reported here.

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Highlights

What is known?

- Globally, the association of children and their mother's body mass index (BMI) is well established.

What is new?

- To our knowledge, this is the first paper that describes the association of adolescents (who are aged 12–14 years) and their mother's BMI from a population of two metropolitan cities in India.

Table 1:

Study sample characteristics in Mumbai and Kolkata

Characteristics	Mumbai (adolescent) n = 843*		Kolkata (adolescent) n = 913*	
	n	Weighted %	n	Weighted %
Mother's BMI (kg/m^2)				
Underweight	38	4.8%	34	3.6%
Normal weight	116	15.9%	162	16.3%
Overweight	213	32.2%	263	36.4%
Obese	290	47.1%	308	43.6%
Other than mother mostly father - BMI kg/m^2				
Underweight	11	2.1%	9	6.7%
Normal weight	37	24.7%	43	23.4%
Overweight	63	34.9%	44	33.5%
Obese	75	38.2%	50	36.5%
Adolescents				
Male	432	50.8%	448	48.2%
Female	411	49.2%	465	51.8%
Underweight (less than the fifth percentile)	41	5.1%	40	4.4%
Normal weight	663	76.1%	732	74.5%
Overweight (from 85th to less than the 95th percentile)	89	11.2%	90	14.2%
Obese (95th percentile or greater)	61	7.5%	40	6.9%
During the past 30 days, how often have you felt lonely?				
Yes	128	14.6%	129	15.0%
No	714	85.4%	782	85.0%

*Numbers may not add due to missing cases; BMI, body mass index

Table 2:

Adjusted odd ratios of parental BMI with overweight and obesity in adolescents (referent category was normal BMI)

	Mumbai (adolescent)*			Kolkata (adolescent)*		
	Underweight	Overweight	Obese	Underweight	Overweight	Obese
Characteristics	**Odds (95% CI)**	**Odds (95% CI)**	**Odds (95% CI)**	**Odds (95% CI)**	**Odds (95% CI)**	**Odds (95% CI)**
Mother's BMI (kg/m^2)**						
Underweight	1.08 (0.27–4.34)	1.26 (0.34–4.62)	3.75 (0.22–63.41)	1.83 (0.27–12.6)	2.01 (0.32–12.67)	6.52 (0.47–89.94)
Overweight + obese	3.65 (1.53–8.73)	4.16† (1.36–12.73)	18.53† (2.02–170.44)	0.36 (0.07–1.7)	4.45† (1.25–15.8)	8.81† (1.40–55.33)
Other than mother mostly father – BMI (kg/m^2)***						
Underweight	4.55 (0.21–100.64)	-	0.8 (0.06–10.32)	6.44 (0.12–355.93)	1.56 (0.07–32.68)	0.62 (0.07–5.35)
Overweight + obese	0.53 (0.07–4.05)	1.59 (0.27–9.4)	-	16.21† (2.03–129.55)	2.59 (0.3–22.32)	-
Adolescents						
Male	1.05 (0.43–2.6)	1.22 (0.59–2.51)	2.79† (1.02–7.58)	1.47 (0.59–3.68)	0.75 (0.45–1.26)	0.59 (0.29–1.22)
Female	R	R	R	R	R	R
During the past 30 days, how often have you felt lonely?						
Yes	0.44 (0.06–3.09)	1.84 (0.81–4.15)	2.91† (1.28–6.63)	0.76 (0.23–2.51)	2.90† (1.61–5.21)	1.57 (0.56–4.44)
No	R	R	R	R	R	R

*Adolescent normal weight as reference category.

**Mother's –normal weight as reference category.

***Other than mother mostly father normal weight.

†indicated by statistically significant odds ratio, "R" indicates reference category. Logistics regression model adjusted by gender and household education as a proxy confounder for SES