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# Food Habits and Body Composition in Children and Adolescents of Asian Indian Origin: A Cross-Sectional Study from West Bengal, India

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## ABSTRACT

The present cross-sectional study was aimed to look in to the association between anthropometric and body composition characteristics with food patterns variables among the children and adolescents in Calcutta, India. A total of 504 healthy children and adolescents (Boys=283 and Girls=221) aged 8-18 years took part in the study. The participants were selected randomly from eight schools in Kolkata, India. Height, weight, circumferences of mid upper arm (MUAC), waist (MWC) and hip as well as skinfold thicknesses at biceps, triceps, subscapular and suprailiac were measured. Percentage of body fat (% BF), body mass index (BMI) and basal metabolic rate (BMR) were measured using an Omron body fat analyser. A pre-tested open ended schedule was used to obtain weekly consumption (frequency) of food stuffs.

The mean age for boys and girls was 13.59 years (SD=1.55) and 13.00 years (SD=2.45), respectively. The weekly consumption of processed fast foods, creamy fast foods, fried snacks, soft drinks, sweets and fats & oils was relatively higher compared to other food items such as leafy vegetables and fish. On the other, more than 10% of the participants used to consume fried snacks ten times in a week. It was also observed that intake of green vegetables had inverse trend with MWC and sum of four skinfolds ($SF_4$). Fried snacks, cream based fast foods, soft drinks and sweets had significant positive association with BMI, MWC and WHR and in turn indicate the detrimental effect to account excess adiposity in children and adolescents.

**KEYWORDS:** Adolescence, body composition, obesity, food patterns, Asian Indians

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## INTRODUCTION

Obesity has become a worldwide problem affecting all levels of society and is being described as a global burden.[1] It has become a serious health burden and is not restricted in prevalence to any particular country or continent rather both developed and developing countries are experiencing this difficulty. [2] Over the past few decades, there has been an alarming, unprecedented increase in the rate of obesity in children and adolescents.[3] At the risk of pediatric obesity has already reached in epidemic proportion worldwide.[4,5] Although, the highest prevalence of childhood obesity has been observed in more developed countries, however, its prevalence is increasing rapidly in developing countries as well. Childhood obesity has become a major public health concern because of its strong association with risk factors of adult chronic diseases such as type 2 diabetes mellitus (T2DM) etc. and subsequent adverse health outcomes.[6]

It is now well recognized that constellation of modifiable risk factors that enhance the risk of cardiovascular diseases (CVD) in adult have their origin as early as childhood and adolescence. Adult chronic conditions such as T2DM, hypertension (HT), dyslipidemia are becoming more common among the children and adolescents as the prevalence of obesity increases.[7] Therefore, the increasing number of obese children and adolescents all over the world demand an investment in the primary and secondary prevention of overweight and obesity in this age group.[7-10]

In many developing countries, the progression of the nutritional transition has been characterized by reduction in the prevalence of nutrition deficiencies. The more expressive occurrence of overweight and obesity in consequences are evident not only in the adult population but also among the children and adolescents[11] and are fundamentally related to changes in lifestyle and eating habits.[12] Food intake has been related to obesity not only in terms of the volume of food ingested but also in terms of the composition and quality of diet.[9] Furthermore, eating habits have also changed and current habits-including the low consumption of fruits, vegetables and milk with increasing consumption of fast foods and soft drinks as well as not having breakfast- are all help to continuous increase in excess adiposity among children and adolescents.[11] Eating habits in addition to environmental differentials represent the most dominant determinant in increasing the tendency of overweight and obesity among children and adolescents.[13]

However, studies pertaining to factors associated with pediatric obesity are few so far as developing countries (e.g. India) are concerned. Moreover, overweight and obesity in children and adolescents and its association with food habits are virtually absent in India. Keeping this view in mind, the present cross sectional study was undertaken to look at the association between

anthropometric and body composition characteristics with food patterns among the children and adolescents in Kolkata (erstwhile Calcutta).

## SUBJECTS AND METHODS

### *Study Population*

The present cross-sectional study comprises of 504 healthy children and adolescents (Boys=283 and Girls=221) aged 8-18 years. The study was undertaken in between June to September, 2017. The participants were selected randomly from eight schools in Kolkata, India. To obtain a better picture, different categories of schools namely private, government sponsored and government schools were considered randomly from Kolkata. Written consent was obtained from the school authorities before actual commitment of the work. This sample size was sufficient to test the research hypotheses at 5% level of significance. An open ended schedule containing information on socio-economic profile, anthropometric and body composition characteristics was used. The responses to the open-ended schedule were free and spontaneous and respondents were not limited in their replies to a particular question posed to them. The sole purpose of using open-ended schedule in the study was to collect quantitative cross-sectional data on food patterns.[14]

Socio-economic and demographic characteristics

The name, age, sex, marital status of parents, maturation status as well as information on socioeconomic characteristics including family type, gross family income and expenditure, occupation of parents were obtained using the same schedule.

Anthropometric and body composition measures

Height, weight, circumferences of mid upper arm (MUAC), waist (MWC) and hip as well as skinfold thicknesses at biceps, triceps, subscapular and suprailiac were obtained using standard techniques.[15] Height and weight of lightly clothed subjects were measured to the nearest 0.1 kg and 0.1 cm respectively. Skinfolds thicknesses were measured on the left side of the body to the nearest 0.2 mm using a Holtain skinfold caliper (Holtain Corporation, UK). Circumferences were measured with an inelastic tape to the nearest 0.1 cm. Percentage of body fat (% BF), body mass index (BMI) and basal metabolic rate (BMR) were measured using an Omron body fat analyser (Omron Corporation, Tokyo, Japan). It is noteworthy to mention that the Pearson's correlation coefficient (r) between analyser operated BMI and manually calculated BMI (weight in kg/height in $m^2$) was 0.92 ($r=0.92$; $p<0.0001$). Fat mass (FM) and FFM was subsequently calculated using the standard equation

### *Food patterns*

A pre-tested open ended schedule 10 was used to obtain weekly consumption (frequency) of food stuffs. Frequency of consumption (average consumption) of vegetables, fruits, creamy products, mutton, chicken, fish, egg, fried snacks, soft drinks and sweets in a week was collected using the same schedule.

### *Statistical analyses*

Descriptive statistics such as mean and standard deviation were undertaken separately for boys and girls. Sex differences for anthropometric and body composition variables were computed using unpaired t test. Spearman's correlation coefficients were also undertaken between body measures and weekly food consumption patterns to see the association between anthropometric and body composition variables with the consumption of fast foods. All statistical analyses were performed using the SPSS (PC+ version 16). A p value <0.05 (two tailed) was considered as significant.

## RESULTS

The socioeconomic characteristic of the study population is represented in Table 1. .

**Table 1. Socio-economic characteristics of the study population (n= 505)**

| Characteristic | Percentage (%) |
|---|---|
| **Monthly family income** | |
| **≥ Rs.3000 – 8000** | **34.7** |
| **≥ Rs. 8001 – 13000** | **23.7** |
| **≥ Rs. 13001 – 18000** | **16.6** |
| **> Rs. 18000** | **24.9** |
| **Type of family** | |
| **Nuclear** | **59.0** |
| **Joint** | **35.0** |
| **Type of residence** | |
| **Own** | **81.0** |
| **Rented** | **18.9** |
| **Education of the parents** | |
| **Primary** | **8.7** |
| **Secondary** | **19.2** |
| **Higher Secondary** | **36.8** |
| **Graduate** | **30.5** |

It was observed that the proportions of the population belonged to the low (≥ Rs.3000–8000), medium (≥ Rs.8001–13000), high (≥ Rs.13001–18000) and very high (> Rs.18000) family income (monthly) was 34.7%, 23.7%, 16.6% and 24.9% respectively. Moreover, most of the participants (59.00 %) were from nuclear family and had their own parental residence (81.00 %). In addition, 30.5 % parent had their education up to college level.

The mean and SD of anthropometric and body composition characteristics are presented in Table 2.

**Table 2. Anthropometric and body composition characteristics in the study population**

| | Boys (n=283) | | Girls (n=221) | |
|---|---|---|---|---|
| Variables | Mean | SD | Mean | SD |
| Age (years)* | 13.59 | 1.55 | 13.00 | 2.45 |
| Height (cm) ** | 154.92 | 11.06 | 147.41 | 10.09 |
| Weight (kg) ** | 54.11 | 13.88 | 49.37 | 13.07 |
| BMI ($kg/m^2$) | 22.22 | 4.14 | 22.33 | 4.43 |
| BMR (kcal) ** | 1472.66 | 215.19 | 1315.20 | 188.14 |
| %BF (%) ** | 21.93 | 7.56 | 26.45 | 5.45 |
| $SF_4$ (mm) ** | 48.32 | 20.14 | 63.91 | 20.88 |
| $Log_{10}$ $SF_4$:BMI ** | 0.30 | 0.14 | 0.44 | 0.11 |
| MWC (cm) | 73.31 | 9.80 | 74.65 | 11.20 |
| WHR** | 0.85 | 0.05 | 0.82 | 0.05 |

BMI= body mass index; BMR= basal metabolic rate; %BF= percentage of body fat; $SF_4$= sum of four skinfolds (biceps + triceps + subscapular + suprailiac); MWC= minimum waist circumference; WHR= waist-hip ratio

Significant at * $p < 0.01$; ** $p < 0.001$

The mean age for boys and girls was 13.59 years (SD=1.55) and 13.0 years (SD=2.45), respectively. Significant ($p<0.01$) sex differences was observed for all anthropometric and body composition variables except BMI and MWC.

The average weekly consumption (frequency) of various food stuffs are presented in Table 3.

**Table 3. Food consumption pattern in the study population**

| Food stuffs | Mean | Lower bound | Upper bound |
|---|---|---|---|
| | (Frequency/week) | (Frequency/week) | (Frequency/week) |
| Oils & Fats | 8.00 | 0 | 8 |
| Green Vegetables. | 8.00 | 0 | 8 |
| Leafy vegetables | 1.62 | 0 | 7 |
| Nut | 1.91 | 0 | 8 |
| Fruits | 8.00 | 0 | 8 |
| Processed fruits | 2.26 | 0 | 8 |
| Inland fish | 2.09 | 0 | 8 |
| Chicken | 1.07 | 0 | 8 |
| Mutton | 0.65 | 0 | 7 |
| Egg | 3.09 | 0 | 8 |
| Processed fast foods | 8.00 | 0 | 8 |
| Soured fast foods | 5.61 | 0 | 8 |
| Fried snacks | 4.09 | 0 | 8 |
| Creamy fast foods | 8.00 | 0 | 8 |
| Soft drinks | 4.58 | 0 | 8 |
| Sweets | 8.00 | 0 | 8 |

It was observed that the weekly consumption of processed fast foods, creamy fast foods, fried snacks, soft drinks, sweets and fats & oils was relatively higher compared to other food items such as leafy vegetables and fish. In fact, most of the participants did not consume leafy vegetables at least once in a week (result was not shown). On the other, more than 10% of the participants used to consume fried snacks ten times in a week and 10.4% subjects had the habit to take soft drinks fourteen times in a week (results were not shown).

Spearman's correlation coefficient between body composition and food pattern variables in the study is presented in Table 4. .

Table 4. **Spearman's correlation coefficient between body composition measures and food pattern variables in the study**

| | BMI | BMR | MWC | WHR | $SF_4$ |
|---|---|---|---|---|---|
| Leafy Vegetables | 0.028 | 0.071 | -0.010 | 0.071 | -0.047 |
| Fruits | -0.014 | 0.008 | -0.008 | 0.059 | -0.090* |
| Processed Fruits | -0.017 | -0.019 | -0.020 | -0.054 | -0.037 |
| Inland Fish | 0.034 | 0.089 | -0.007 | 0.043 | -0.008 |
| Egg | 0.023 | 0.0001 | 0.005 | 0.006 | 0.010 |
| Chicken | 0.038 | -0.040 | 0.048 | 0.021 | 0.068 |
| Soured FF | 0.064 | 0.065 | 0.053 | 0.046 | 0.025 |
| Fried Snacks | 0.099* | 0.055 | 0.092* | 0.086 | 0.077 |
| Cream based FF | 0.193** | 0.178** | 0.204** | 0.183** | 0.169** |
| Soft drinks | 0.151* | 0.147** | 0.179** | 0.128** | 0.110** |
| Sweets | 0.003 | 0.186 | -0.010 | 0.085 | -0.070 |

FF= Fast food

*Significant at 5% level

** Significant at 0.1% level

There was a inverse trends observed for the consumption of leafy vegetables with MWC and $SF_4$. In contrary, fried snacks, cream based fast foods, soft drinks and sweets had significant positive association with BMI, MWC, WHR and $SF_4$.

## DISCUSSION

Economic transition during the last 3 decades has considerably changed nutritional and lifestyle habits in India. Food become more affordable to larger number as the price has decreased substantially relative to income and the concept of food has changed form a mean of nourishment to a marker of lifestyle and a source of pleasure, coupled with physical inactivity have likely contributed to the increase in the prevalence of overweight and obesity in children.[16] The present cross-sectional study was aimed to look at the association between anthropometric and body composition characteristics with food patterns among the children and adolescents in Kolkata.

It was observed that boys had significantly greater mean for height, weight and BMI compare to girls who on the other hand had significantly greater mean values for %BF and $SF_4$. The higher BMI in boys is not only due to accumulation of fat but also due to the muscle mass or fat free mass.[17-21] Greater amount of %BF and subcutaneous fat in girls could be due to greater influence of female sex hormone on centripetal fat depots. [9, 22]

It was reported that obese children and adolescents usually consume significantly more servings of meat and alternatives, fast foods, sugar sweetened drinks and potato chips which contribute to a higher calories, fat, and sugar intake compared to non-obese children and adolescents.[23] In the present study also, significant positive association between fast foods (both fried and cream based) and body composition measures (BMI, MWC, WHR and $SF_4$). The reason could be due to fast foods contains high level of trans fatty acids (TFA) that contributes to increase blood cholesterol level and reduces the protective high density cholesterol level in blood.[9, 13, 24] In fact, TFA has a higher tendency to promote high level of low density lipoprotein cholesterol (LDL-c) like saturated fatty acids than the natural saturated fatty acids.

In a study, it was observed that variety of sweets, snacks, condiments, entrees, and carbohydrates were positively associated with body fatness while only variety of vegetables was negatively associated with body fatness.[25] An almost similar finding was also observed in the present study where significant positive association was noticed between atherogenic body fatness (e.g. WHR) and intake of variety of fast foods, soft drinks and sweets. Furthermore, no significant association of inland fish, egg and chicken with body composition could be due to low weekly consumptions of these items. In a study on adult Bengalee Hindu men in Calcutta, significant ($P<0.01$) negative associations of chicken and fish consumption with central obesity measures indicated that they may have a beneficial effect in this population.[9] On the other hand, the significant positive associations of egg, fried snacks and Bengalee sweets consumption with central obesity measures suggested that these foods may have an adverse effect.[9] It is noteworthy to mention here that trans fatty acids in the Indian diets are mostly derived from Vanaspati, (hydrogenated vegetable oil) a type of cooking medium frequently used to prepare snacks and sweets. With widespread and increasing use Vanaspati, intake of trans fatty acid is likely to increase further in the Asian Indian population.9 This fact, irrespective of age and sex, is critically important in people of Asian Indian origin where one of the highest incidences of CHD has been recorded.

However, longitudinal studies investigating the interaction between obesity measures, metabolic and food pattern variables are needed to further our understanding about the onset of CVD risk factors in children and adolescent. More studies on migrant children and adolescent of Indian origin also needed. Such studies, when done in comparison with the native population, should yield

valuable information about the 'gene-environment' interaction involved in the onset of atherosclerosis risk factors in pediatric population. Furthermore, vast cultural heterogeneity results in differences in food consumption among different Indian communities across the 'Indian Diaspora'. This difference in food consumption, no doubt, is a potential risk for CVD risk factors in Indian children and adolescent. In this respect an enlightened public health policy, including dietary guidelines, is necessary to retard the growing incidence of pediatric obesity (one of the major CVD risk factors) among the Indian children and adolescents. However, at present no such policy existed in India.

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