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# Obesity, Motor Quality and Physiological Developement Among Urban Preadolescent Children From Midnapore, India

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***Abstract:*** *In present time obesity has attained a major focus of research as one of the nutritional problems in developed and developing countries. In India this number is increasing day by day due to changing life style in all age group. In this study the prevalence of overweight and obesity were estimated from 105 school going Bengali preadolescent children from middle income-group urban families of Midnapore town, West Bengal, India. They were divided into control, overweight and obese group of each sex according to the respective BMI percentile value. Anthropometric variables, physiological variables, and several motor quality variables were measured. Result obtained revealed that the prevalence of obesity was 18.8% among boys and 23% among girls. The obese group showed increased value of anthropometric parameters. There were significant differences of all of the variables in between control, overweight and obese girls and boys except hand grip strength of both sexes and standing long jump of boys. Product moment correlation showed all variables were significantly correlating with BMI and % of fat. Obese girls were showing higher values of anthropometric parameters and lower values of physiological and motor parameters in comparison with obese boys. Thus this developing urban community is in a growing concern for their growing proportion of obese individual as they are under a substantial handicap in physical performance.*

***Keywords:*** *Obesity, BMI, Motor Quality, Respiratory Fitness*

## I. Introduction

Accumulation of excess fat in the body is termed as obesity. Although a number of factors contributing to the development of obesity are well established, the etiology of obesity is not exactly clear (Tucker et al. 1997). Watanabe et al. (1994) observed obesity to a large extent as the result of physical inactivity with the maintenance of an abundant and frequently high fat diet. Incidences of childhood obesity have been increasing since 1980s (Han et al. 2010).The children in developing countries suffering from double forms of malnutrition. Urban children are afflicted with problems of over-nutrition while rural and slam children suffer from effects of under nutrition (Chatterjee et al. 2002). According to Bessesen (2008), 10% of children worldwide are either overweight or obese. 50-80% of obese preadolescent children will grow up to become obese adults (Styne et al. 2001).

Childhood obesity is associated with several risk factors for the development of heart diseases and other chronic problems including hyperlipidemia, hyperinsulinemia, hypertension and early atherosclerosis (Berenson et al. 1993; 1998, Cole et al. 2000). The correlation of childhood obesity to adulthood diseases is of major concern (Chatterjee et al. 2006) as it because harder to treat obesity in adults than in children (Park et al. 2005). So effective prevention of adult diseases due to obesity will require the prevention and management of childhood obesity (WHO, 2000).

Selected body measurements like stature, mass, various skinfold thicknesses and other body dimensional measurements have globally been accepted as sensitive indicators of growth progress and nutritional status of children and the growing population.(Pakrasi et al. 1986; Chatterjee et al. 1993) In order to develop an internationally acceptable definition of obesity, Cole et al .(2000) scientifically specified cut-off points of BMI, a ratio of body mass and stature which are the two most easily measurable parameters, for categorizing children as obese in an age-wise pattern.

As excessive body weight affects body geometry and increases the mass of different body segments, there is obstruction in different physiological, aerobic and motor response in those over weight and obese children in same physiological conditions. This changing trend in body weights in children is important for public health policy. The objective of this study was to determine the prevalence of obesity in a representative sample of urban preadolescent school going children from the Midnapore town, West Bengal, India. The other objective was to correlate several physiological, aerobic and motor quality variables of obese among non obese subjects.

## II. Materials AND Methods

**Selection of Subjects:**

This cross sectional investigation was undertaken with 105 (53 boys and 52 girls) school going healthy children between the ages 10 to 12 years from middle socioeconomic class (ICMR Technical Report, 1972) Bengali families. The age of each subject was calculated from the date of birth as recorded in their school register. The children were randomly sampled from different schools of Midnapore town, West Bengal, India. Each child underwent a one-day testing session. During this session, anthropometric assessments and other tests were carried out (Comitato. 1988, Council of Europe, 1983).

**Measurement of Anthropometric parameters**

**Measurement of Height and Weight:**

Height was measured in the upright position to the nearest millimeter and body mass was determined using a balance with a 100-gm minimum detectable limits (Cole et al. 2000).

**Determination of BMI:**

BMI were calculated according to the method mentioned by Meltzer et al (1988). The obese and overweight children were separated from the non-obese according to the international cut off points of BMI as proposed by Cole et al. (2000) and also following the guidelines of WHO. Among boys, 29 were normal weight, 14 overweight and 10 obese. Among girls, 26 were normal weight, 14 overweight and 12 obese. The underweight boy and girls were excluded from my study.

**Measurment of skinfold thickness:**

The skinfold measurements included the triceps, sub-scapular chest, abdomen, mid-thigh and calf were taken on the right side of the body with the children standing in the proper upright posture according to methods proposed by Johnson et al. (1988) using a calibrated skinfold caliper with constant tension (Norton et al. 1996). Obesity was further confirmed by the fat percent value as proposed by Watanabe et al. (1994).

**Measurement of physiological parameters**

**Determination of aerobic capacities**:

Children were asked to take complete rest for half an hour before performing the exercise so that pulmonary ventilation and pulse rate might come down to a steady state. The Queen's College Step Test (QCT) which has been recommended as a valid and reliable indirect method for prediction of $Vo_{2max}$ (Chatterjee et al. 2001) was adopted in the present investigation. In brief, the step test was performed using a stool of 16.25 inches (or 41.30 cm) height. Stepping was done for a total duration of 3 minutes at the rate of 24 cycles per minute. After completion of the exercise, the subjects were asked to remain in standing posture comfortably and the carotid pulse rate was measured from the fifth to the twentieth second of the recovery period. This 15 second pulse rate was converted into beats per minute and the following equation was used to predict $Vo_{2max}$. **$Vo_{2max}$ (ml/kg/min) = 111.33 – (0.42 × pulse rate in beats per min)** for boys and = 65.81 – (0.1847 X **pulse rate in beats per min)** for girls**.** All experiments were performed at a room temp varying from 27–29°C and at a relative humidity ranging between 70 and 85% (Mcardle, 2001).

**Measurement of respiratory rate :**

Respiratory rate was measured according to the method mentioned by Simoes et al. 1991.

**Measurement of motor quality variables**

**Measurement of standing long jump:**

Children were made standing behind a line marked on the ground with feet slightly apart. A two foot take-off and landing was used, with swinging of the arms and bending of the knees to provide forward drive. The subject attempted to jump as far as possible, landing on both feet without falling backwards. Three attempts were allowed. The measurement was taken from take-off line to the nearest point of contact on the landing (back of the heels). The longest distance was recorded (Ward et al. 2005).

**Measurement of handgrip strength** :

A calibrated hand dynamometer with adjustable grip was used. Children were asked to hold the dynamometer in their both hand, at their side without touching the rest of the body, and squeeze it forcefully keeping the instrument held in line with the forearm during the duration of the test. Children were required to squeeze gradually and continuously for at least 2 seconds. The best result was the score recorded in kilograms (Ignacio et al. 2007).

**Determination of hand reaction time :**

The children sited on a chair with such a height that their forearm was in comfortably resting position. The tips of the thumb and index finger were held in a ready to pinch position about 3 or 4 inches beyond the edge of the table. The upper edge of the thumb and index finger were in a horizontal position. The tester holds the stick timer near the top, letting it hang between the subject's thumb and index finger. The children were directed to look at the stick and were told to react by catching the stick when it was released. The children were not allowed for locking at the tester's hand; nor were they allowed to move their hand up or down while attempting to catch the falling stick (Johnson et al. 1974). The children were allowed for ten times.

**Determination of running speed:**

A 10x2 m shuttle running and turning test at maximum speed were conducted for all students. Two parallel lines were drawn on the floor separated by 5 meter. Both feet of the child had to cross the line each time. The time needed to complete two cycles (back and forth) was recorded as the final score. All children were motivated to run as fast as they could (Ignacio et al. 2007).

**Statistical analysis:**

Descriptive statistics were run on all variables. One way ANOVA was performed to study the existence of significance in the difference of means of variables among different subject groups. Further Scheffe's multiple comparison analysis was conducted. Pearson's product moment correlation was adopted to establish the relationship between variables. Unpaired two tail t-test was performed to test significance of difference between the means of variables between boys and girls.

## III. Result AND Discussion

Table-1 & 2 represents the mean values and standard deviations of all variables. The obese and overweight individuals were observed have higher values of body mass comparing with normal individuals. The girls were found to have higher mean values of weight, BMI, percent of fat than boys. Many paper reported significantly higher values for body mass in all sexes in obese group as also observed in the present study and this is accredited to the excess accumulation of fat mass among obese individuals (Buskirk et al. 1974). Mean stature and body mass data for non-obese preadolescent corroborate with the previous study in rural boys of West Bengal (Chatterjee et al. 1993). BMI was significantly higher among obese children because of the significantly higher body mass when compared to non-obese children. Mean BMI values for all ages further establish the relevance of proper categorization of children into obese and non-obese groups with respect to the primary aim of the current study. In relation to gender, national published data showing that boys have almost double the prevalence of obesity than girls at the age of 6 to 9 years. However, in agreement with data previously published (**Moreno et al. 2001**), our results indicate opposite findings, as illustrated by the significantly lower proportion of obese boys (18.8%) in relation to obese girls (23%). A study from Delhi reported the prevalence of obesity as 7.4% (WHO 2002), While another study done in school children in Punjab reported prevalence of overweight and obesity to be 11.1% and 14.2% respectively (Chhatwal et al. 2004). A study conducted in Pune documented the prevalence of obesity 5.7% and overweight 19.9% (Khadikar et al., 2004)

**Table:1 Comparison of anthropometric, physiological and motor quality variables of boys.**

| Variables | | **Boys** | | |
|---|---|---|---|---|
| | **Normal(a)(N-29)** | **Overweight(b)(N-14)** | **Obese(c)(N-10)** | **LS** |
| | | | | |
| | | | | |
| **Wt.(Kg)** | 27.72±0.37 | 36.00±0.35 | 44.20±1.90 | **(ab)(bc)(ca) |
| **BMI(kg/m2)** | 14.86±0.19 | 19.09±0.26 | 23.15±1.04 | **(ab)(bc)(ca) |
| **Fat %** | 8.44±0.23 | 11.27±0.48 | 16.78±1.39 | **(ab)(bc)(ca) |
| **LBM** | 26.64±0.37 | 33.92±0.48 | 39.09±1.72 | **(ab)(bc)(ca) |
| **$VO_2$max(ml/kg/m)** | 41.02±0.31 | 39.92±0.26 | 40.00±0.31 | *(ab) |
| **RR(c/m)BF** | 21.20±0.37 | 21.64±0.31 | 20.80±0.32 | ns |
| **RR(c/m)AF** | 38.45±0.85 | 39.46±1.20 | 41.25±1.40 | *(bc)(ac) |
| **SLJ(cm)** | 139.95±1.43 | 142.22±1.60 | 136.50±2.29 | ns |
| **HGS(kg)R** | 12.31±0.53 | 15.07±0.72 | 13.60±1.01 | ns |
| **HGS(kg)L** | 11.72±0.42 | 13.78±0.52 | 11.70±0.76 | ns |
| **HRT(sec)** | 0.16±0.02 | 0.15±0.01 | 0.18±0.02 | **(bc)(ac) |
| **TRST(sec)** | 8.99±0.21 | 9.01±0.18 | 10.04±0.28 | **(bc)(ac) |

**Table:2 Comparison of anthropometric, physiological and motor quality variables of girls.**

| Variables | | Girls | | |
|---|---|---|---|---|
| | **Normal(a)(N-26)** | **Overweight(b)(N-14)** | **Obese(c)(N-12)** | **LS** |
| | | | | |
| | | | | |
| **Wt.(Kg)** | 30.60±0.44 | 41.71±0.80 | 48.91±2.09 | **(ab)(bc)(ca) |
| **BMI(kg/m2)** | 17.30±0.14 | 21.33±0.36 | 26.81±0.83 | **(ab)(bc)(ca) |
| **Fat %** | 11.90±0.56 | 14.40±0.58 | 21.57±0.78 | **(ab)(bc)(ca) |
| **LBM** | 23.20±0.58 | 31.39±0.47 | 34.79±1.21 | **(ab)(bc)(ca) |
| **$VO_2$max(ml/kg/m)** | 40.75±0.25 | 40.10±0.21 | 38.21±0.26 | *(bc)(ac) |
| **RR(c/m)BF** | 21.10±0.31 | 21.00±0.27 | 18.21±0.41 | ns |
| **RR(c/m)AF** | 37.50±0.84 | 38.05±1.20 | 38.45±1.24 | *(ab)(ac) |
| **SLJ(cm)** | 138.00±1.60 | 141.91±1.77 | 133.29±2.57 | **(bc) |
| **HGS(kg)R** | 11.10±0.49 | 11.57±0.54 | 12.25±0.53 | ns |
| **HGS(kg)L** | 10.40±0.47 | 10.35±0.57 | 10.83±0.34 | ns |
| **HRT(sec)** | 0.15±0.02 | 0.14±0.02 | 0.17±0.01 | **(ab)(bc) |
| **TRST(sec)** | 8.70±0.19 | 9.46±0.24 | 10.26±0.29 | **(ab)(ac) |

LBM-Lean Body Mass, RR-Respiratory Rate, SLJ-Standing Long Jump, HGS-Hand Grip Strength, HRT-Hand Reaction Time. Values are ±SEM, One way ANOVA was performed to compute the means, *p<0.05, **p<0.01, ns-not significant, Scheffe's multiple comparison test was performed between group a,b,c/ab-aVb,p<0.05;bc-bVc,p<0.05;ac-aVc,p<0.05.

Analysis of the association between BMI and physiological and motor variables in preadolescent children revealed that as the BMI values increased physiological and motor quality variable decreased. Similar findings have been reported earlier (Kelishadi et al. 2003; Flodmark et al. 2006; Moayeri et al. 2006). For preadolescent children, not only motor activities are important, aerobic fitness can also be used as a good predictor for some incoming health risks like hyperinsulinemia, hypercholesterolemia, and others in future (Gutin et al. 2004; 2005). Our result are in agreement with several studies showing that respiratory fitness levels in preadolescents are low and that fitness can be used to detect those children with enhanced risk of cardiovascular disease (Ortega et al. 2005; 2007; Gutin et al. 2005).

In this study we observed there is no significant difference in $Vo_{2max}$ in overweight and normal weight group. But there is significantly low value of $Vo_{2max}$ in obese group as compared to both sexes. This probably indicates that ability to perform exhausting work is less in obese individuals. Buskirk et al. (1957), Chatterjee et al. (2005) also observed similar results. A lower $Vo_{2max}$ indicate the oxygen consumption per unit of body mass was significantly less in the obese group. This is probably because of the excessive amount of body fat that appeared to exert an unfavorable burden as well as hindering action towards cardiac function, particularly during exhausting exercise when excessive hyperactive body musculature fails to uptake sufficient amount of oxygen due to deposition of proportionately high amount of fat mass.

According to Table-3, strong positive correlation to all variables with BMI and lean body mass was observed. Similar results were found in study reported by Welch (1957), Buskirk and Taylor (1957), Chatterjee (2005). Our purpose of the study was to investigate gross motor skill in overweight and obese children in comparison with normal-weight children. The inverse relationship between motor skill competence and body weight is often explained from a mechanical point of view, because obesity influences body geometry and increases the mass of different body segments. As children with movement difficulties perceive themselves less competent than other children, they are less likely to be physically active and they show preference for sedentary pastime (Bouffard et al. 1996; Cairney et al. 2005; 2006). Such an activity deficit may however strengthen their lack of motor skill. Table-4 represents the comparison of different variables between controls, overweight and obese boys and girls and it was observed that anthropometric parameters have significantly higher values in obese girls. On the other hand physiological and motor quality variables have lower values in obese girls in comparison with obese boys.

**Table:3 Product-moment correlation coefficients of BMI and % of Fat with different variables.**

| Variables | **Boys** | | **Girls** | |
|---|---|---|---|---|
| | BMI | Fat% | BMI | Fat% |
| **$VO_2$max(ml/kg/m)** | * | * | * | * |
| **RR(c/m)BF** | * | * | * | * |
| **RR(c/m)AF** | ** | * | ** | * |
| **SLJ(cm)** | ** | * | ** | ** |
| **HGS(kg)R** | * | * | * | * |
| **HGS(kg)L** | * | * | * | * |
| **HRT(sec)** | ** | ** | * | ** |
| **TRST(sec)** | ** | * | *** | *** |

* P< 0.0; ** P<0.01:***P<0.001

**Table:4 Comparison of different variables of control, overweight, obese boys and girls.**

| Variables | Normal | | | Overweight | | | Obese | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | Girls | LS | Boys | Girls | LS | Boys | Girls | LS |
| | | | | | | | | | |
| **Wt.(Kg)** | 27.72±0.37 | 30.60±0.44 | ns | 36.00±0.35 | 41.71±0.80 | * | 44.20±1.90 | 48.91±2.09 | ** |
| **BMI(kg/m2)** | 14.86±0.19 | 17.30±0.14 | ns | 19.09±0.26 | 21.33±0.36 | * | 23.15±1.04 | 26.81±0.83 | ** |
| **Fat %** | 8.44±0.23 | 11.90±0.56 | ** | 11.27±0.48 | 14.40±0.58 | ** | 16.78±1.39 | 21.57±0.78 | ** |
| **LBM** | 26.64±0.37 | 23.20±0.58 | ns | 33.92±0.48 | 31.39±0.47 | ** | 39.09±1.72 | 34.79±1.21 | * |
| **VO2max(ml/kg/m)** | 41.02±0.31 | 40.75±0.25 | ns | 39.92±0.26 | 40.10±0.21 | ns | 40.00±0.31 | 38.21±0.26 | ** |
| **RR(c/m)BF** | 21.20±0.37 | 21.10±0.31 | ns | 21.64±0.31 | 21.00±0.27 | ns | 20.80±0.32 | 18.21±0.41 | * |
| **RR(c/m)AF** | 21.20±0.37 | 37.50±0.84 | ns | 21.64±0.31 | 38.05±1.20 | ns | 20.80±0.32 | 38.45±1.24 | * |
| **SLJ(cm)** | 139.95±1.43 | 138.00±1.60 | ns | 142.22±1.60 | 141.91±1.77 | ns | 136.50±2.29 | 133.29±2.57 | * |
| **HGS(kg)R** | 12.31±0.53 | 11.10±0.49 | ns | 15.07±0.72 | 11.57±0.54 | * | 13.60±1.01 | 12.25±0.53 | ns |
| **HGS(kg)L** | 11.72±0.42 | 10.40±0.47 | ns | 13.78±0.52 | 10.35±0.57 | * | 11.70±0.76 | 10.83±0.34 | ns |
| **HRT(sec)** | 0.16±0.02 | 0.15±0.02 | ns | 0.15±0.01 | 0.14±0.02 | ns | 0.18±0.02 | 0.17±0.01 | ns |
| **TRST(sec)** | 8.99±0.21 | 8.70±0.19 | ns | 9.01±0.18 | 9.46±0.24 | ns | 10.04±0.28 | 10.26±0.29 | ns |

Data are presented as mean; LS-Level of Significance;*p<0.05;**p<0.01

Evidences from several national health surveys in Asia points to significant differences in prevalence of overweight and obesity among countries (Ge et al. 1997; Ko et al. 1997; Yoshiike et al. 1998; Aekplakorn et al. 2004; Griffiths et al. 2001). Asian countries such as Taiwan and China have experienced rapid increases in prevalence of childhood obesity (Chu et al. 2005; Wu et al. 2006). Rapid economic growth has improved the nutritional, socioeconomic and health status of those countries (WHO 2003). Obesity has increased markedly with this nutritional evolution in most Asian countries (Popkin et al. 1998). A similar nutritional transition is under way in India (Griffiths et al. 2001). In addition to the nutritional and socioeconomic transitions, the behavioral transition of children is also possibly contributing significantly to the rapidly rising prevalence of obesity. Unhealthy eating habits and physical inactivity are the major culprits (Bar et al. 1998). The sedentary lifestyle of children and adolescents have been attributed mainly to television viewing, computer games, internet, overemphasis on academic excellence, unscientific urban planning and ever-increasing automated transport (Bar et al. 1998). The differences in prevalence and trends of overweight and obese preadolescent children could be due to these influences. Lifestyle changes and an active policy to develop awareness among people regarding these influences could probably be a mode to combat these backgrounds.

## IV. Conclusion

In this study we focused on several anthropometric, physiological and motor quality variables of preadolescent children from an urban area and found some of the children were overweight and obese. Statistical analysis of the variables reveals that there is increasing uncomfortable situation due to weight gain comparing with normal children. Disease causing factors are present in high percentage in those children with overweight and obesity comparing with children who were neither overweight nor obese. Unless effective interventions and preventive strategies are instituted at the local and national level, the trend of increasing cardiovascular and other disease in adults observed in recent decades will accelerate even further.

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