Childhood Obesity and Its Relationship with Selected Motor Quality and Physiological Parameters including Risk Factors for Coronary Artery Disease in 5-12 Years Old Boys

Aims

The aims of this study was to find out the effect of childhood obesity on motor quality development and its relation with risk factors for development of coronary artery disease of the school going healthy Bengali boys at the age group of 5-12 years from middle socioeconomic class families.

Methods

This cross- sectional study was conducted in different urban private schools in three district towns of West Bengal in India during the period of 2012 to 2015. In the present study, initially total 1450 boys of age range 5 to 12 years were included from middle socioeconomic class Bengali families which were considered in accordance with the guidelines proposed by **Agarwal A (2008).** On the basis of exclusion criteria, finally 1036 boys were selected and data obtained from them in connection with the study. The boys were divided according to their chronological age in four groups such as 5- <7years, 7 – <9 years, 9 - <11years, 11- <13 years. Further according to WHO growth chart **(WHO, 2007)**, on the basis of BMI-age-boys Z-scores (normal weight: - 2SD > BMI Z score ≤ + 1SD, overweight: BMI Z-score ≤ +2SD, obese: BMI Z-score > +2SD) and also following the proposed guidelines of **Cole et al. (2002)** for boys, selected subjects in each age group were categorised in three subdivisions such Normal weight, Overweight and Obese.

Keeping in view the feasibility criteria and the relevance of the variables in the present study several selected anthropometric, motor quality, physiological, biochemical and nutritional parameters were studied to understand the effect of childhood obesity on motor quality

development and its relation with risk factors for development of coronary artery disease. The measurements includes height, weight, body mass index (BMI), waist circumference (WC), hip circumference, thigh circumference, waist to hip ratio (WHR) and waist thigh ratio (WTR) were calculated which represent the degree obesity. On the other hand, motor quality parameters included hand reaction time (HRT), foot reaction time (FRT), speed of movement (SOM), agility, 30 meter sprint, vertical jump test and standing long jump test scores were calculated which represents the effect of obesity on motor quality development. The selected biochemical parameters included fasting serum lipids i.e., total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDLC) and low density lipoprotein cholesterol (LDLC). The ratio of total cholesterol to high density lipoprotein cholesterol (TC ÷ HDLC) was also calculated. Other two biochemical parameters such as fasting blood glucose and uric acid were also calculated. The selected physiological parameters included resting pulse rate, resting respiratory rate, systolic blood pressure and diastolic blood pressure and physical fitness index (PFI). The selected nutritional parameters included average daily intake of carbohydrate, protein, fat, calorie, vitamin A, ascorbic acid, vitamin D, vitamin B12, folic acid, iron, calcium and zinc.

Results

1. It was observed from the present study that the prevalence of being overweight and obesity in the selected boys were 26.83% and 17.76% respectively.
2. Body mass index, waist circumference, and hip circumference, WHR, WTR and body fat % were significantly differed from each other in three body weight categories in all age groups. There was general tendency of increasing BMI, waist circumference, hip circumference, thigh circumference and tendency of decreasing the WHR and WTR with advancement of age. All the percentile values (i.e., 5^{th},

10^{th}, 25^{th}, 75^{th}, 90^{th} and 95^{th}) of BMI, body fat%, waist circumference were found to be higher in obese category than in normal weight and overweight category.

3. The present study also reveals that the mean values of HRT, FRT, SOM, agility, 30 meter sprint were significantly lower in normal weight category than in overweight and obese category in same age specific strata. On the other hand, mean values of VJT and SLJT were significantly higher in normal weight category than in overweight and obese category. In contrary, mean values of VJT and SLJT were significantly higher in overweight category than in obese boys in all selected age group. It is also observed from the study that there was general tendency of decreasing HRT, FRT, and SOM, agility, sprint and tendency of increasing VJT and SLJT with progression of age in each body weight category.
4. Present study also demonstrated that all the selected percentile values (the 5^{th}, 10^{th}, 25^{th}, 75^{th}, 90^{th} and 95^{th}) of VJT and SLJT to be higher in normal weight category than in overweight and obese category in same age groups. In contrary, all selected percentile values of HRT, FRT, SOM, and agility were found to be higher in normal weight category than in overweight and obese category in same age groups.
5. It is also evident from the present study that there existed significant and negative correlation between age with HRT, FRT, SOM, agility and 30 meter sprint. On the other hand, age had significant and positive correlation with the VJT and SLJT. Conversely, in multiple regressions analysis it was found that there were independent negative relationship age with selected time related motor quality parameters and also age had independent positive association with VJT and SLJT.
6. Present study also reveals that the reaction time was positively correlated with the BMI, body fat percentage, WHR and WTR. On the other hand, VJT and SLJT

values had significant and negative correlation with the BMI, fat percentage, WHR and WTR.

7. The multiple linear regression coefficient β showed that WHR, WTR had independent positive relationship with time related motor quality parameters but significant and negative correlations were found in case with VJT and SLJT.
8. Mean values of resting respiratory rate and resting pulse rate were significantly lower in normal weight category when compared with the overweight and obese category in same chronological age groups. On the other hand, mean SBP and DBP were significantly higher in overweight and obese category than in normal weight category in all age groups. It was also observed from the study that there was general tendency of decreasing pulse rate, respiratory rate and tendency of increasing SBP and DBP with advancement of age in every body weight category.
9. It is also noted from the study that the highest (95^{th}) percentile values of pulse rate and respiratory rate were higher in obese category than normal weight and overweight category. Lowest (5^{th}) to highest (95^{th}) percentile values of SBP and DBP were found to be higher in obese category than in normal and overweight category.
10. The present study also reveals that there were negative correlation between age with respiratory rate, pulse rate respectively and positive correlation with SBP and DBP. On the other hand, BMI and fat percentage were negatively but not significantly correlated with the respiratory rate and pulse rate. Conversely, WHR and WTR had significant positive correlation with the respiratory rate, pulse rate, SBP and DBP. Moreover, body mass index and body fat percentage each had significant and positive correlation with SBP and DBP.

11. In multiple linear regression analyses the age had independent negative significant relationship with the respiratory rate, pulse rate and independent significant positive relationship with SBP & DBP.
12. Multiple linear regressions analyses also showed that even after controlling the effect of age and body fat percentage, BMI had independent significant positive relationship with the SBP and DBP. On the other hand, in multiple regression analysis, 'standard partial regression coefficient' showed the independent positive relationship WHR with pulse rate, respiratory rate, SBP, and DBP.
13. It is also evident from the present study that mean values PFI scores were significantly higher in normal weight boys when compared with the overweight and obese category in 11- <13 years age group. The present study also reveals that there were significant negative relationships of BMI and body fat percentage with physical fitness index scores. Conversely, WHR and WTR were negatively associated with the physical fitness index. In multiple regression analyses showed that BMI had independent significant negative relationship with physical fitness score.
14. The present study also reveals that the mean values of serum total cholesterol (TC) were significantly higher ($p < 0.05$) in overweight category than in normal weight category in similar age group. On the other hand, mean values triglycerides (TG) were significantly ($p < 0.05$) higher in obese boys than in normal weight boys. Moreover, mean values of LDLC were significantly higher in overweight and obese weight category when compared with the normal weight category in same chronological age group. In contrast, TC: HDLC ratio was significantly higher ($p < 0.05$) in overweight and obese category than in normal weight category in all age groups except with the 5 – < 7 years age group.

15. It is evident from present study, the mean values of blood glucose were significantly higher in overweight and obese category when compared with the normal weight category in all age groups except in 5 – <7 years age group. On the other hand, the mean values of serum uric acid were significantly ($p < 0.05$) higher in obese boys than in normal weight boys in 9 – <11 years & 11 – <13 years age group. It is also observed from present study that there were general tendency of increasing the TC, TG, LDLC and TC: HDLC ratio with advancement of age.
16. Lowest (5^{th}) and highest (95^{th}) percentile values of TC, TG, LDLC and TC to HDLC ratio were found to be higher in obese category than in normal weight category in all age groups. Also lowest (5^{th}) and highest (95^{th}) percentile values of blood glucose and uric acid were found to be higher in obese category than in normal weight category in all age groups.
17. The present study showed that there existed significant positive correlations of age with lipid profile, blood glucose and uric acid. On other hand, the correlation of BMI and body fat % with TC, TG, LDLC, TC: HDLC, blood glucose and uric acid were positively associated. Conversely, BMI and body fat percentage were negatively correlated with the HDLC. On the other hand, WHR had positive correlations with the TC, TG, LDLC, and TC: HDLC and blood glucose but negative correlation was found with the HDLC. WTR was negatively correlated with the HDLC. In contrast, SBP and DBP were significantly and positively correlated with the TC, TG, LDLC, and TC: HDLC and blood glucose. On the other hand, SBP & DBP were negatively correlated with the HDLC.
18. In multiple linear regressions analyses age had independent significant and positive relationship with the TC, LDLC, and TC: HDLC, blood glucose and uric acid. On the other hand, in multiple regressions analyses also showed that even after

controlling the effect of age and body fat percentage, BMI had independent significant positive relationship with the TG, blood glucose and uric acid. Moreover, multiple analyses showed that fat% had independent positive relationship with the LDLC

19. Multiple analyses demonstrated that even after controlling the effect of age, WHR had strong significant impact on lipid profile. Therefore, the WHR and WTR may the best obesity markers for the variability of the lipid profile in this population.
20. The present study also reveals that the mean values of carbohydrate, fat and total calories were significantly higher in overweight and obese category than in normal weight category in all age groups. On the other hand, mean values of protein were significantly higher in normal weight category than obese category. In contrast, among micronutrients, the absolute intakes of vitamin A, vitamin D, calcium and zinc were lower than recommendations (RDA) in all weight category in all age groups except in 5 – <7 years age group.
21. The present study also showed that there was positive significant correlation of SBP and DBP with different nutrient intake. On the other hand, SBP and DBP were negatively correlated with the calcium intake.
22. It is evident from the present study that BMI and body fat percentage had significant positive correlation with different nutrient intake but BMI and body fat percentage were negatively correlated with Vitamin D and iron.
23. Present study also evident that there were significant negative correlation between times related motor quality parameters with different nutrient intake. On the other hand, length related motor quality parameters were positively correlated with nutrient intake.

24. The present study also reveals that the selected coronary artery risk factors (TC, TG, HDLC, LDLC and TC: HDLC) are highly prevalent among boys in overweight and obese category. Additionally, the prevalence of fasting serum uric acids and blood glucose levels were also higher in overweight and obese boys.

Conclusion

From this study it can be interpreted that BMI, waist circumference, thigh circumference, WHR and WTR remarkably high due to higher level of body fat percentage in overweight and obese boys. Higher level of BMI and body fat percentage has a negative effect on motor performance skill. This study has also demonstrated that prevalence of overweight (26.83%) and obesity (17.76%) exists in urban school going children in West Bengal in India. Prevalence of obesity is increased due to intake of high-calorie rich foods with little quantity of vitamins, micronutrients, mineral and less physical activity. From the present study demonstrated that among the anthropometric indices, BMI and body fat percentage had a significantly correlation with all lipid profile. It was also observed that waist hip ratio is partly good determinant of abnormalities in lipid profile. Our present study also showed that central obesity marker WHR is partially good predictor of blood sugar and uric acid abnormalities. Thus, the inclusion of measurement of TC, TG, HDLC, LDLC, blood sugar and uric acid levels in the assessment protocols for obese or overweight children in order to verify possible complications of early cardiovascular disease and type 2 diabetes.

The information obtained from this study can therefore be used in the set of intervention programmes for school children in 5 - 12 years of age. Future studies require employing a longitudinal design to completely recognize the composite relations of obesity related health hazards in 5 to 12 years old Bengali boys. This should include identification of children who are, or who are at risk of becoming, obese. A healthy diet should be followed

by the child and family. Education regarding nutrition and developing healthy eating and lifestyle habits should be the focus. Children should be encouraged to participate in different sports related activities. Health-promotional physical fitness is negatively affected to a great degree in children between the ages of five and twelve years who are overweight and obese.