

A Prospective Study of Homocysteine and its relation to Body Mass Index and Lipid Profile in School Children

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Objective: To study the serum Homocysteine levels in children and its relation with body mass index (BMI), lipid profile and plasma glucose. **Methods:** 138 children (age 5-15 y) were enrolled and categorized into normal, overweight and obese group. Blood homocysteine, lipid profile and plasma glucose were estimated. **Results:** Out of 138 children, 46 (33%) were normal, 40 (29%) were overweight and 52 (38%) were obese. Hyper-homocysteinemia was found in 34 (24.6%) of children. None of the normal children had hyperhomocysteinemia in contrast to 15 (37.5%) in overweight and 19 (36.5%) in obese group ($P=0.001$). The median homocysteine levels in obese and overweight children was significantly higher compared to normal children ($P=0.001$). There was a positive correlation between BMI and homocysteine levels. There was no significant correlation between lipid profile and plasma glucose with homocysteine levels. **Conclusions:** Serum homocysteine levels are significantly higher in both overweight and obese children compared to normal children.

Keywords: Metabolic, Obesity, Overweight, Risk factors.

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The prevalence of childhood overweight and obesity, which is a major risk factor for development of cardiovascular disease (CVD) at a younger age, has shown rising trend in India [1]. Even moderate elevation of homocysteine levels is shown to be associated with an increased risk of CVD in children [2]. Four-fold increased risk for ischemic cerebrovascular diseases is reported when serum homocysteine levels exceed the 95th centile for age [3]. Serum homocysteine is considered as one of the modifiable, independent risk factor for CVD in adults [4]. As the risk begins early in life, estimation of homocysteine levels in children offers an early opportunity for the primary prevention [4,5]. This study aimed to determine homocysteine levels and its relation with age, gender, body mass index (BMI) lipid profile and blood sugar in obese and overweight children, and compare them with normal children.

METHODS

This is a cross-sectional study of 138 children between the age group of 5 and 15 years conducted between August 2014 and December 2015 in a rural residential school of Mysuru, India. Children on treatment with steroids, antipsychotics, anti-epileptics, vitamin B12 or folic acid were excluded. The study was approved by the JSS Institutional Ethical Committee and informed

consent was obtained from parents. Homocysteine levels, lipid profile and fasting plasma glucose were estimated on automated analyzer (Randox Imola, BIO-02RX, model OPT790DT).

Statistical analysis: Correlation was estimated by Pearson product moment correlation. Comparison of categorical variables was done by chi square test, or Fischer exact test. Mann Whitney U test was used for comparison of medians.

RESULTS

We studied a total of 138 children of whom, 46 (33%) children were normal, 40 (29%) were overweight and 52 (38%) were obese as per WHO BMI charts. The median homocysteine levels in obese children and overweight children was significantly higher compared to normal children ($P<0.001$). The median homocysteine level in girls was higher as compared to boys ($P=0.031$) (**Table I**).

Overall hyper-homocysteinemia was found in 34 children. None of the children in normal group had hyperhomocysteinemia as compared to 15 (37.5%) in overweight group and 19 (36.5%) in obese group ($P<0.001$). There was no gender difference in the prevalence of hyper-homocysteinemia (**Table II**).

TABLE I COMPARISON OF HOMOCYSTEINE LEVELS ($\mu\text{MOL/L}$) BETWEEN DIFFERENT GROUPS

Category Parameter	Weight			Age group		Gender	
	Normal	Overweight	Obese	5 - 10 yrs	11 - 15 yrs	Male	Female
Number	46	40	52	66	72	91	47
Homocysteine level [#]	7.3 (5.5-10.5)	16.7 (11.2-22.5)	16.6 (13.3-22.4)	13.7 (10.3-19.7)	12.9 (7.4-19.5)	11.8 (7.7-19.0)	15.6 (11.5-20.7)

The median homocysteine levels in obese children and overweight children was significantly higher compared to normal children ($P < 0.001$) and $P = 0.031$ for comparison between boys and girls.

TABLE II PROPORTION OF HYPERHOMOCYSTEINEMIA IN VARIOUS GROUPS

	Normal	Over weight	Obese	Male	Female
Normal Homocysteine	46 (100%)	25 (62.5%)	33 (63.4%)	70 (%)	34 (%)
Hyper homocysteinemia*	0 (0.0)	15 (37.5%)	19 (36.5%)	21 (%)	13 (%)

*Serum Homocysteine value $> 20 \mu\text{mol/L}$; $P < 0.001$ for comparison between normal and overweight, and between normal and obese.

The homocysteine levels in children between the age of 5 and 10 years and children between 11 and 15 years were not significantly different (**Table I**). There was a positive correlation between BMI and homocysteine levels (**Fig. 1**). There was no statistically significant correlation between lipid profile and plasma glucose with homocysteine levels.

DISCUSSION

This study showed a strong association of homocysteine levels with obesity and overweight in school children. This suggests that the risk of cardiovascular disease may increase as the BMI increases, even before obesity sets in. Closer to one-third of overweight and obese children were observed to have hyperhomocysteinemia, whereas none of the normal weight children had hyperhomocysteinemia.

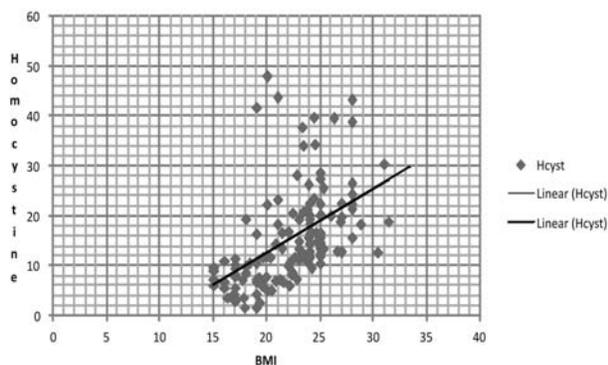
The major limitation of the study was that we did not assess the vitamin B12 and folate levels, which are well

known to influence homocysteine levels. Other limitations are convenience sampling, small sample size and non-assessment of functional outcomes related to hyper-homocysteinemia.

The significant difference in homocysteine levels between overweight and obese children when compared to normal children in our study is similar to observations made from various countries [6,7]. In contrast, few other studies have found no significant difference between obese, overweight and normal children with respect to hyperhomocysteinemia [8,9]. Genetic and ethnic factors playing role in the homocysteine homeostasis is indicated in several reports where higher concentrations of homocysteine in immigrant ethnic Indian adults compared to North Americans and European whites [10,11]. This could have contributed for the difference in the results noted in our study and that of others.

Our observation of significant positive correlation between homocysteine levels and BMI is similar to few other studies from various countries [2,3,6,10,12]. We did not find any statistically significant correlation between homocysteine levels and lipid profile similar to other studies [4,12]. Huemer, *et al.* [3] showed that homocysteine concentration correlated positively with triglycerides but not cholesterol. The variations of homocysteine levels and its correlation with other risk factors among various studies may be due to the fact that many factors like ethnicity, age, gender and nutritional status affects homocysteine metabolism and its serum concentrations.

To conclude, serum homocysteine levels are significantly higher in both overweight and obese

**FIG. 1** Correlation between BMI and Homocysteine Levels.

WHAT THIS STUDY ADDS?

- Serum homocysteine levels and the prevalence of hyperhomocystenemia in overweight children is similar to that seen in obese children suggesting that the risk may increase as the BMI increases even before obesity sets in.

children compared to normal children. Currently, obesity is considered as disease and overweight is not. This approach need to be relooked in order to pick children at-risk at the earliest.

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