Chattagram Maa-O-Shishu Hospital Medical College Journal
Volume 15, Issue 2, July 2016

Original Article

Fasting Serum Insulin Level Among Overweight and Obese School Children

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Abstract

Background: The rising prevalence of obesity in developing countries is largely due to rapid urbanization and mechanization which has led to reduction in the energy expenditure. It is accompanied along with an increase in energy intake due to increased purchasing power and availability of high fat, energy dense fast food. A high prevalence of obesity in children can be attributed to the lack of knowledge about adverse effects of unhealthy nutrition in urban school children in Bangladesh. So there is a need to identify overweight and obesity as one of the risk factors leading to condition of metabolic syndrome and or central obesity and give baseline information to approach for its prevention at childhood with the assistance from continuation of medical research as early as possible. **Methods:** This was a case control study. A total of 100 subjects were included in this study. Among them 50 were considered as cases (Whose BMI was >85th percentile) and 50 were considered as controls (Whose BMI was > 5th percentile to 84th percentile). BMI were calculated by standard protocol used for children. Children suffering from DM, renal diseases and other endocrine diseases were excluded. Serum insulin, blood glucose, total cholesterol, LDL-C, HDL-C and TG were measured in all samples in fasting state. Insulin resistance was calculated by HOMA-IR value. **Results:** Result showed that serum insulin and HOMA-IR values were significantly higher in cases (Overweight and obese children) than in controls of same age and sex (p=<0.001). Result also showed that there were positive correlation among Total Cholesterol (p=<0.001), LDL-C (p=<0.001), TG (p=<0.001) and HOMA-IR value. **Conclusion:** We found that insulin resistance was strongly associated with metabolic syndrome and its components.

Key words: Fasting serum insulin; Overweight and obese; School children.

INTRODUCTION

The prevalence of chronic or non-communicable disease is escalating much more rapidly in developing countries than that in industrialized countries. According to World Health Organization estimates, by the year 2020, non-communicable diseases will account for approximately three quarters of all deaths in the developing world[1]. Obesity is a major risk factor for chronic diseases and plays a central role in the ''insulin resistance'' or ''metabolic syndrome'' which includes hyperinsulinemia, hypertension, hyperlipidemia, type 2 diabetes mellitus, and an increased risk of atherosclerotic cardiovascular disease[2,3]. The metabolic syndrome is a common pathophysiologic condition with implications for the development of many chronic diseases. Obesity beginning in childhood often precedes the hyperinsulinemic state and tends to persist into adulthood[4,5]. Identifying individuals with increased fasting insulin level is crucial as it increases the risk of developing type 2 diabetes by five-fold and CVD by two-fold along with consequences of metabolic syndrome[6].

MATERIALS AND METHOD

The study was a case control study which conducted in the Department of Biochemistry, Chittagong Medical College from July 2014 to June 2015.

Proper permission was taken for this study from the Ethical Review Committee of Chittagong Medical College, Chittagong, Bangladesh, to determine the HOMA (Homestatic Model Assessment) IR value and lipid profile among the overweight & obese school going children.

The children of different schools of Chittagong City fulfilling the enrollment criteria were included in this study.

Laboratory parameter: Chemiluminescence enzyme immunometric assay for the quantitative determination of human insulin concentrations in human serum by Siemens immulite 2000 systems. Total Cholesterol (TC) and Triglyceride (TG), HDL-C were estimated by enzymatic method. The glucose oxidase-peroxidase method was used for measurements of fasting plasma glucose. All measurements were analyzed in automated analyzer (Siemens Germany). Low-Density Lipoprotein-Cholesterol (LDL-C) was calculated by the Friedewald formula. (LDL = Total Cholesterol - HDL - 1/5 TG) mg/dl[7]. Insulin resistance was calculated by using the HOMA model [HOMA-IR = fasting insulin (IU/mL) × fasting glucose (mmol/L)/22.5]. HOMA-IR cut off is > 2.5[8]. A given fasting normal value of serum insulin = 5 to 15 IU/mL (According to American Diabetic Federation) and fasting plasma glucose = 3.9 to 6.1 mmol/L.

Body Mass Index (BMI): Body height and weight was measured according to a standardized protocol with participants standing without shoes and heavy outer garments. Body Mass Index (BMI) was calculated as weight in kilograms divided by the square of the height in meter (kg/m^2).

RESULTS

Table 1 : Distribution of the study groups (n = 100).

Study Groups	Frequency	Percentage (%)
Group A		
(Overweight & Obese Children)	50	50.0
Group B		
(Normal Control)	50	50.0
Total	100	100.0

Table demonstrates that one hundred (100) subjects were included in this study. Of them fifty (50) were cases (Group A) and fifty were controls (Group B).

Table 2 : Distribution of fasting serum insulin level among the study groups (With t - test significance).

	Study Group	N	Mean	± SD	Range
Serum	Group A	50	20.21	11.28	6.10 - 55.50
Fasting Insulin	Group B	50	10.35	4.56	5.13 - 34.90
(µIU/L)	TOTAL	100	15.28	9.89	5.13 - 55.50

t value = 5.732. p 0.001. Highly Significant.

Table shows that mean fasting insulin level is significantly higher in cases than that in controls (20.21 ± 11.28 vs 10.35 ± 4.56, p < 0.001).

Table 3 : Distribution of HOMA-IR value among the study groups (with t - test significance)

	Study Group	N	Mean	± SD	Range
HOMA-IR	Group A	50	4.50	1.95	1.38 - 8.40
Value	Group B	50	2.47	1.11	1.20 - 8.33
	TOTAL	100	3.49	1.88	1.20 - 8.40

t value = 6.392. p < 0.001. Highly Significant.

Table shows that mean HOMA-IR value is significantly higher in cases than that in controls (4.50 ± 1.95 vs 2.47 ± 1.11, p < 0.001).

Table 4 : Table Distribution of insulin resistance status among the study groups (With Chi square test significance).

Insulin Resistance Status	Study Groups: Group A		Group B		Total	
	n	%	n	%	N	%
Present	42	84.0	14	28.0	56	56.0
Absent	08	16.0	36	72.0	44	44.0
Total	50	100.0	50	100.0	100	100.0

χ^2 value = 20.543. p = 0.000. Highly Significant.

It is observed that 84% cases (n-42) and 28% controls (n-14) are identified with insulin resistance status. Insulin resistance status is significantly higher in cases than that in controls.

Table 5 : Distribution of metabolic syndrome status among the cases according to NCEP ATP III criteria of metabolic syndrome.

CRITERIA	Metabolic Syndrome Status	N	Mean	± SD	Range	Sign.
BMI (Kg/m2)	Present	09	36.15	5.45	30.34 - 44.50	p < 0.001 Highly Significant
	Absent	41	30.18	4.30	25.10 - 44.44	
Serum TG (mg/dl)	Present	09	177.67	24.05	150 - 218	p < 0.001 Highly Significant
	Absent	41	104.83	19.14	71 - 148	
Serum HDL Cholesterol (mg/dl)	Present	09	36.44	3.39	32 - 42	p > 0.05 Not Significant
	Absent	41	36.07	3.04	31 - 43	
Serum Fasting Insulin (µIU/L)	Present	09	33.93	12.90	21.00 - 55.50	p < 0.001 Highly Significant
	Absent	41	17.20	8.42	6.10 - 51.00	

Table 6 : Distribution of serum lipid profiles according to metabolic syndrome status of the study group (n = 100) (With t - test significance).

	Metabolic Syndrome Status	N	Mean	± SD	Range	Sign.
Serum Total Cholesterol (mg/dl)	Present	10	167.00	43.92	103 - 243	p = 0.001 Highly Significant
	Absent	90	130.56	32.09	86 - 202	
Serum LDL Cholesterol (mg/dl)	Present	10	103.50	27.14	67 - 148	p = 0.007 Highly Significant
	Absent	90	74.03	10.28	59 - 109	
Serum HDL Cholesterol (mg/dl)	Present	10	37.00	3.65	32 - 42	p = 0.013 Significant
	Absent	90	40.28	4.26	31 - 43	
Serum TG (mg/dl)	Present	10	175.50	23.68	150 - 218	p = 0.000 Highly Significant
	Absent	90	97.09	18.54	65 - 150	

Table shows that mean serum total cholesterol, LDL cholesterol and TG levels are significantly higher among metabolic syndrome group than non-metabolic syndrome group (167 ± 43.92 vs 130.56 ± 32.09, 103.50 ± 27.14 vs 74.03 ± 10.28 and 175 ± 23.68 vs 97.09 ± 18.54) mg/dl. Serum HDL cholesterol is significantly lower among metabolic syndrome group than non-metabolic syndrome group (37 ± 3.65 vs 40.28 ± 4.26 mg/dl).

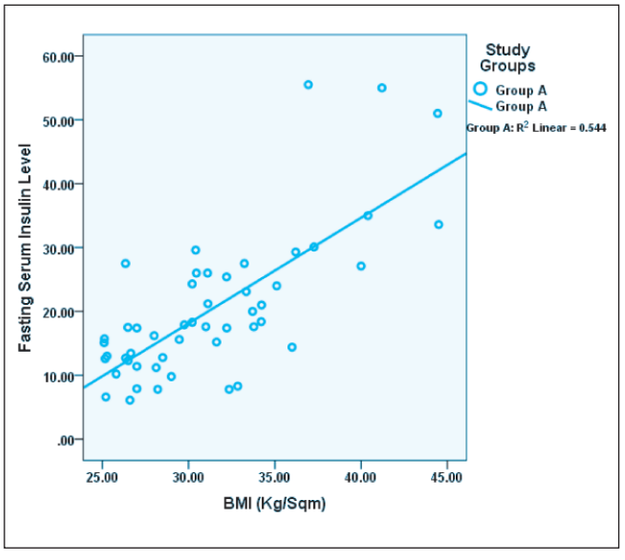

Figure 1 : Scatter diagram showing positive correlation between BMI and fasting serum insulin level.

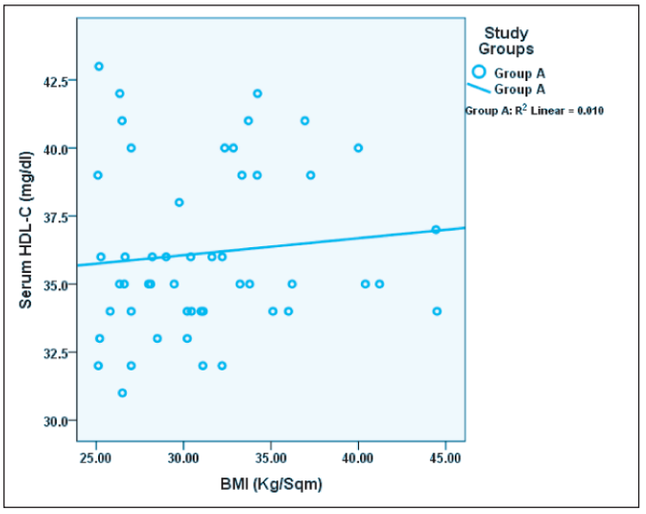

Figure 2 : Scatter diagram showing correlation between BMI and fasting serum HDL level.

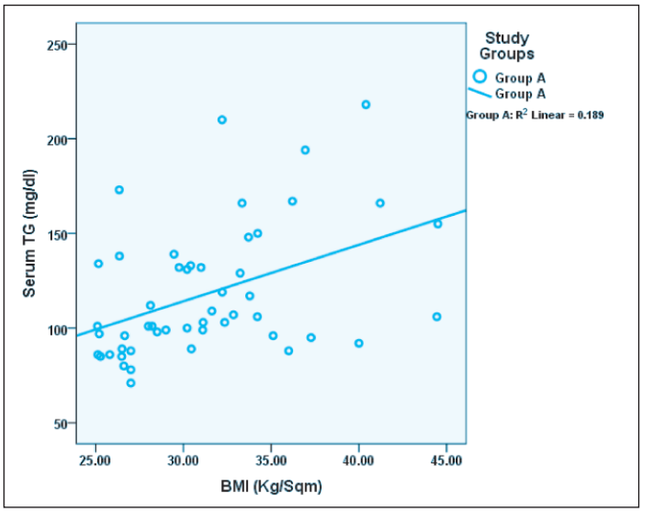

Figure 3 : Scatter diagram showing positive correlation between BMI and fasting serum TG level.

DISCUSSION

Fasting serum insulin level among the study groups were statistically analyzed and observed to possess significant increased values in serum who were overweight and obese school children. On the other hand it is observed that 84% cases (n-42) were identified with insulin resistance status (HOMA-IR > 2.5). Insulin resistance in this study is well defined in the cases and found to be associated with increased body weight (BMI). Mean HOMA-IR is 6.92 in metabolic syndrome group and 3.11 in without metabolic syndrome group in cases of group A. By using HOMA-IR cutoff value, insulin resistance was found in 84% of overweight and obese children (Mean