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Original article:

A study of fasting plasma glucose, serum uric acid, lipid profile and thyroid hormones in adolescents in the age group of 15-20 years with special reference to BMI

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Abstract:

Introduction: Obesity is a term used to describe individuals with excess body fat. Excess calorie intake coupled with lack of enough physical activity results in obesity. Obesity may occur during childhood (juvenile onset) or in adults. Obesity is associated with metabolic disorders-hyperlipidaemia (with elevation of both cholesterol and triglyceride), gall stones, hyperuricaemia and gout and non insulin dependent diabetes mellitus.

Materials and Methods: The present study was consisted of 120 students between the age group of 15-20 years of both genders which were randomly selected from 1st professional MBBS students, paramedical students and students from regional college of nursing. Fasting plasma glucose (FPG), serum uric acid, lipid profile and thyroid hormones were estimated with special reference to BMI. The study subjects were grouped according to BMI, Group I with BMI 18.5-24.9, Group II with BMI 25-29.9 and Group III with BMI>30 of both genders.

Observations and results: A statistically significant difference of fasting plasma glucose was found between group I and III ($P<0.05$). The mean TSH levels showed significant difference between group I and group III ($P<0.001$) and between group I and group II ($P<0.05$).There was a significant difference of the mean uric acid levels between group I and group III ($P<0.05$). Among the lipid profile total cholesterol and LDL cholesterol were very significantly elevated ($p<0.001$).

Conclusion: Obesity is most frequently associated with Diabetes mellitus. The results of the present study showed that there was a positive correlation between FPG and BMI>30(Group III) and between TSH and BMI>30(Group III). Dyslipidemia appears to be associated with the progress of Diabetes mellitus.

Key words: Obesity, dyslipidemia, HDL cholesterol, LDL cholesterol

Introduction:

Obesity is defined as a risk factor in a host of pathological conditions, including diabetes mellitus, hypertension and cardiovascular disease[1].Several risk factors have been identified for obesity and cardiovascular disease. The most important risk factors related to obesity and cardiovascular disease are diabetes, dyslipidemia, sedentary lifestyle and hypertension. Obesity is currently identified as a major health problem[2].Among the above risk factors lipids have been widely investigated due to their extensive correlation with atherosclerosis. That is the

reason that hyperlipidemia has been introduced as an important risk factor for atherosclerosis and cardiovascular disease[3, 4]. One of the proven risk factors for cardiovascular disease and diabetes is body visceral fat, which is significantly associated with body lipids and lipoproteins[3-6.]

Prevalence of obesity has increased along with the increasing in the incidence of metabolic syndrome[7].The increasing prevalence rate of obesity in childhood makes it necessary to identify children at risk for implementing preventive interventions[5].In juvenile onset obesity there is an increase in both the number and the size of adipocytes where in adult obesity fat is accumulated only in already existing adipocytes. There are certain degree of genetic predisposition proposed in the development of obesity[8].In modern day urban civilization people are more habituated to consuming food with excess calories coupled with sedentary lifestyle[9].Cardiovascular disorders are also increased with obesity. Physical inactivity which may be both a cause and effect of obesity also play an important role in the genesis of IHD.[10, 11].

Aims and objectives:

1. To determine the fasting plasma glucose, serum uric acid, lipid profile and thyroid hormones in adolescents in the age group of 15-20years with special reference to BMI.
2. To identify the people at risk for implementing preventive intervention towards reducing obesity and overweight.

Material & methods:

The present study was conducted in Gauhati Medical College and Hospital from april 2015 to November 2015.The study included 120 students between the age group of 15-20 years, from 1st professional MBBS students, paramedical students and students from regional college of Nursing.

A pre-tested questionnaire was used to record the age, height, weight, waist circumference (WC), Hip circumference (HC) and waist to hip ratio (W/H).The BMI was calculated by dividing weight (kg) by height (m^2) and the subjects were grouped according to BMI.

The study was approved by the institutional Ethical clearance Committee of Gauhati Medical College. A written informed consent was obtained from all the subjects who were enrolled in our study.

Inclusion criteria: The study subjects were included in between the age group of 15-20 years of both genders and some having overweighted or obesity, and grouped according to BMI in three categories.

Group I: 40 students with BMI 18.5-24.9 of both genders

Group II: 40 students with BMI 25-29.9 of both genders

Group III: 40 students with BMI>30 of both genders.

Exclusion criteria: Subjects with any hepatic disease, type I diabetes mellitus, peripheral vascular disease, acute or chronic infection, cancer and diabetes mellitus with complications like ulcers, nephropathy and neuropathy were excluded from the study as all these conditions might affect the estimation of various biochemical parameters.

Venous blood samples were collected under strict aseptic conditions with a minimum of 8 hours of fasting. All the parameters were estimated using Johnson and Johnson Vitros5600 dry chemistry auto analyzer.

The blood glucose estimation was done by Glucose oxidase peroxidase method (GOD-POD), TSH estimation was done by Chemiluminescent immunometric immunoassay method, Uric acid was

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estimated by uricase method, Total cholesterol (TC) was estimated by cholesterol oxidase method, Triglyceride estimation was done by Enzymatic colorimetric test-GPO PAP, High density lipoproteins (HDL) estimation was done by Direct Enzymatic method, LDL and VLDL –cholesterol were calculated using Friedwald's formula. Statistical analysis was carried out by one way analysis of varience (ANOVA) by using software "GraphPad Instat version3".

P value<0.05 was considerd significant and Pearsons Correlation Coefficient was used to rank different variables either positively or inversely correlated. All the statistical graphs were prepared using Microsoft Excel 2007.

Observations & results:

The mean fasting plasma glucose levels were 80.15±7.78, 83.6±8.58, and 86.13±8.15 respectively in group I, group II and group III. Statistical analysis shows significant difference of FPG between group I and III (P<0.05), however no significant difference was found neither between group I and II, nor group II and group III. (Table 1.1, Graph I)

The mean TSH levels were 2.2±0.79, 2.93±1.18 and 3.11±0.864 respectively in group 1, group II and group III. The TSH levels showed significant difference between group I and group III (P<0.001) and between group I and group II (P<0.05), however there was no significant association between group II and group III. (Table 1.1, Graph II)

The mean serum uric acid levels were 5.05±1.31, 5.32±1.62 and 5.88 ±1.4 in group I, group II and group III respectively. There was a significant difference between group I and group III (P<0.05). (Table1.1, Graph III)

Among the lipid profile total cholesterol and LDL cholesterol were very significantly elevated (p<o.oo1), (Table 1.1, Graph IV&VI).

The Pearsons correlation coefficient between FPG and BMI>30(Group III) were positively correlated which was significant (p=0.0192) (Table 1.2, Fig I).There was also found positive correlation between TSH and BMI>30(Group III). (Tab 1.2, Fig II)

Among the lipid profile, the Pearson's correlation coefficient of total cholesterol, Triglycerides and LDLc was found positively correlated with BMI>30 and negatively correlated with HDLc. (Table1.2, Fig IV, Fig VI, Fig V)

However, no significant correlation was found between VLDL cholesterol and uric acid with BMI>30(Table1.2).

Parameters	**Group I(BMI 18.5-24.9) (Mean± SD)**	**Group II (BMI 25.5-29.9) (Mean± SD)**	**Group III (BMI >30) (Mean± SD)**	**p value**
FPG(mg/dL)	80.15 ± 7.78	83.6 ± 8.58	86.13 ± 8.15	0.006**
TSH(mIU/L)	2.2 ± 0.799	2.93 ± 1.18	3.11 ± 0.864	<0.0001***
Uric Acid(mg/dL)	5.05 ± 1.31	5.32 ± 1.62	5.88 ± 1.4	0.043*
T. Cholesterol(mg/dL)	128.35 ± 25.03	129.33 ± 31.56	151.95 ± 24.56	<0.0001***
Triglyceride(mg/dL)	110.28 ± 55.24	121.8 ± 52.18	134.23 ± 38.84	0.039*
LDL(mg/dL)	65.93 ± 20.28	70.98 ± 30.11	89.58 ± 23.16	<0.0001***
HDL(mg/dL)	39.88 ± 7.82	38.13 ± 7.56	35.7 ± 3.96	0.037*
VLDL(mg/dL)	22.6 ± 12.96	24.2 ± 10.4	26.53 ± 8.07	0.042*

*significant(<0.05),**very significant(<0.001),***extremely significant(<0.0001),^{NS}Not significant

Table 1.1: showing comparision of biochemical parameters between the three groups. Anova test and Bartlett test were used for comparison of means between the three groups.

Parameters	**Group III (BMI>30)**
FPG	r= 0.3688
	p= 0.0192
TSH	r= 0.325
	p= 0.0408
T. Cholesterol	r= 0.3207
	p= 0.0436
Triglyceride	r= 0.017
	p= 0.3752
LDL	r= 0.3425
	p= 0.0305
HDL	r= -0.3366
	p= 0.0337
VLDL	r= 0.1772
	p= 0.2739
Uric acid	r= 0.0857
	p= 0.2751

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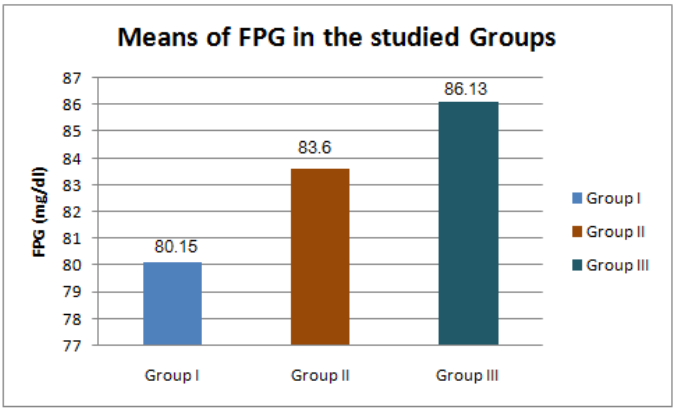
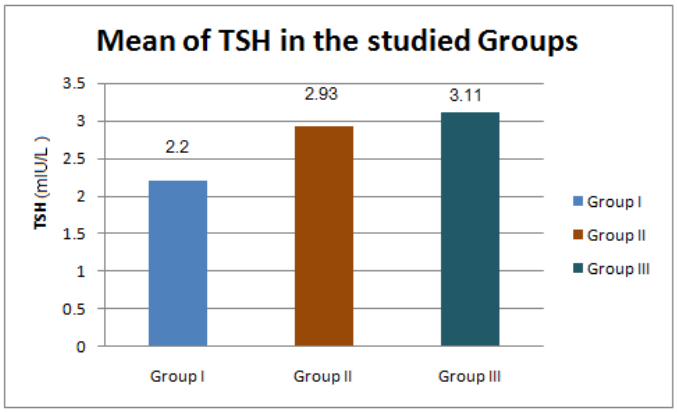
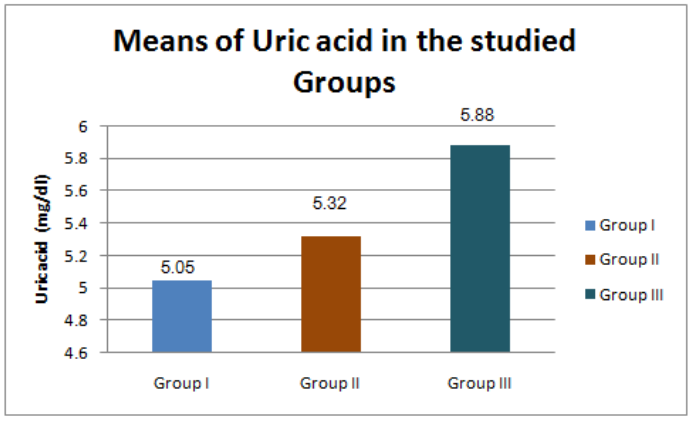
Table1.2: showing correlation between BMI and other biochemical parameters in Group III (BMI>30)



Graph I: Showing means of FPG in the studied groups



Graph II: Showing means of TSH in the studied groups



Graph III: Showing means of Uric acid in the studied groups

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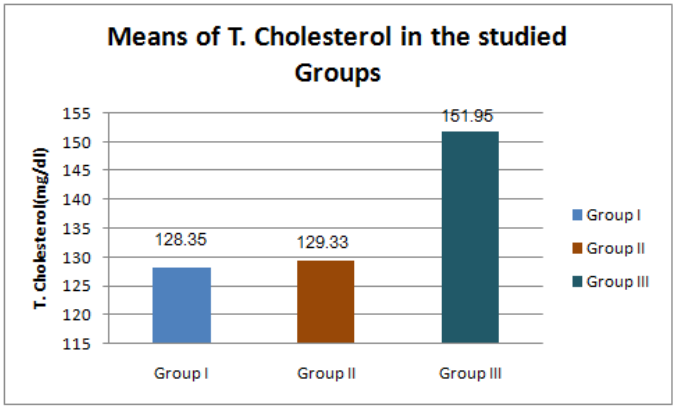
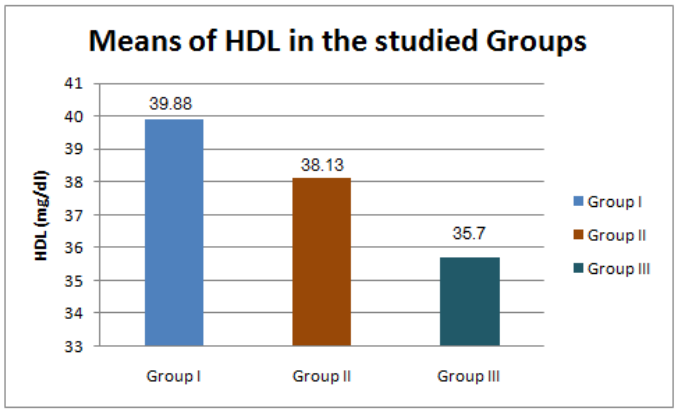
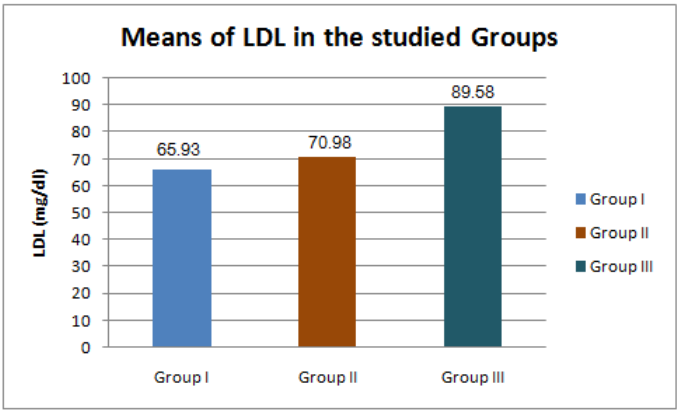


Graph IV: Showing means of T. Cholesterol in the studied groups



Graph V: Showing means of HDL in the studied groups



Graph VI: Showing means of LDL in the studied groups

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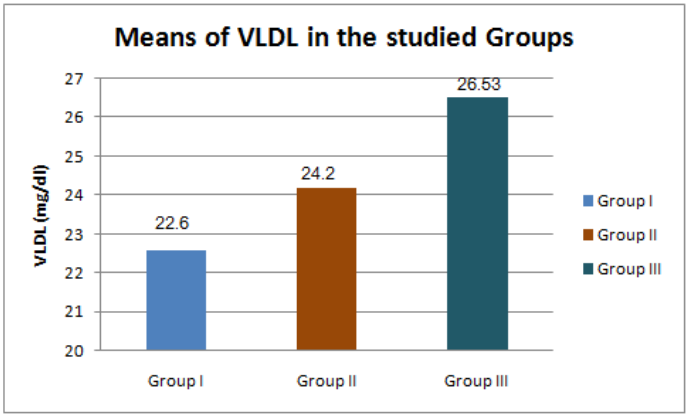
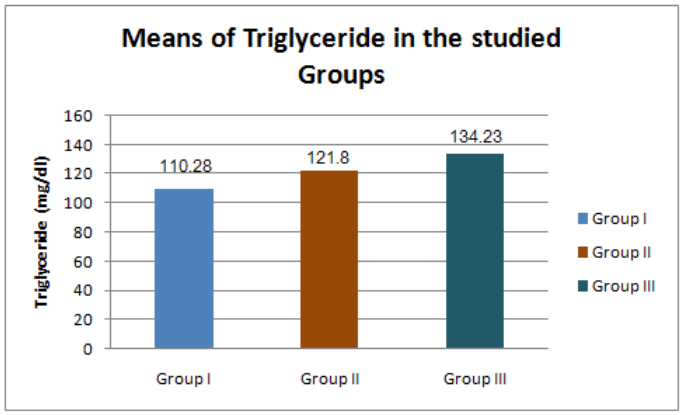


Graph VII: Showing means of VLDL in the studied groups



Graph VIII: Showing means of triglyceride in the studied groups

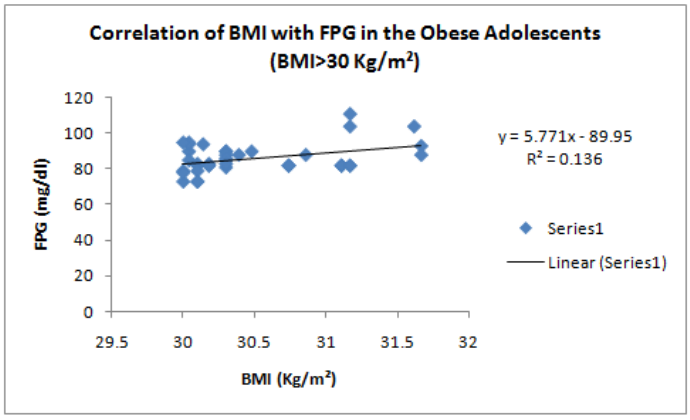


Fig I: Showing correlation of BMI with FPG in the obese Adolescents (BMI>30 Kg/m^2)

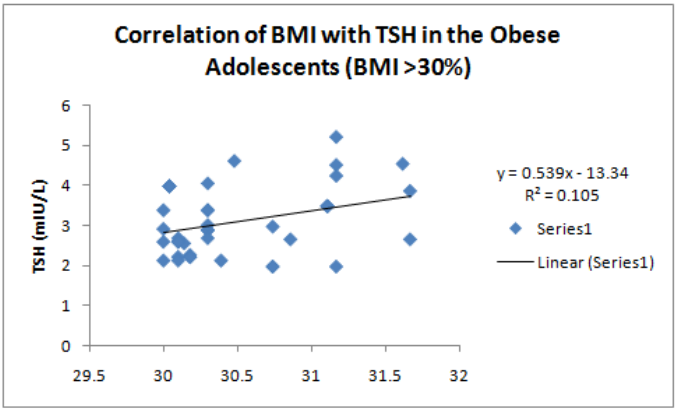


Fig II: Showing correlation of BMI with TSH in the obese Adolescents (BMI>30 Kg/m^2)

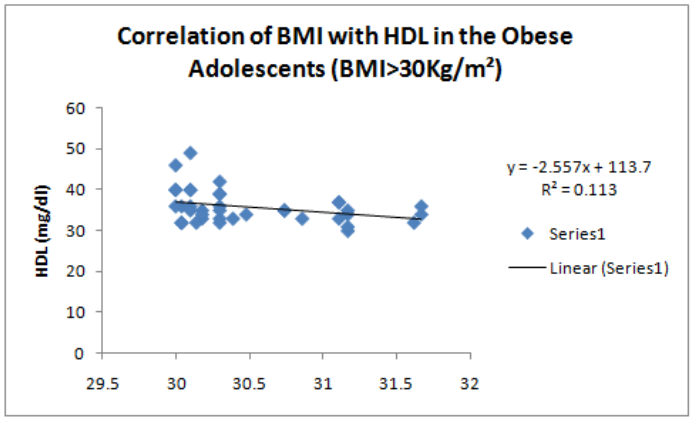


Fig III: Showing correlation of BMI with HDL Cholesterol in the obese Adolescents (BMI>30 Kg/m^2)

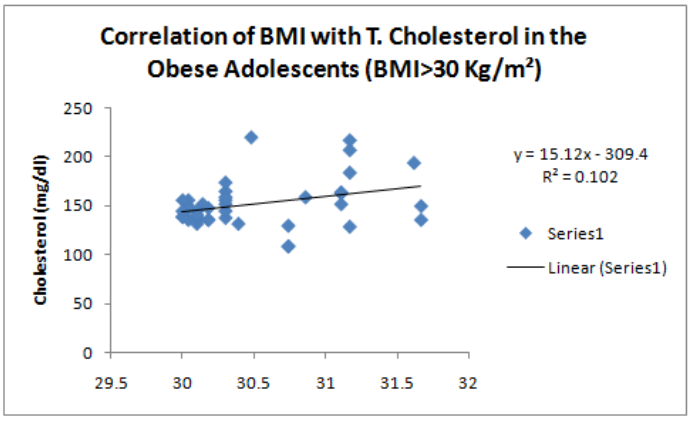


Fig IV: Showing correlation of BMI with T. Cholesterol in the obese Adolescents (BMI>30 Kg/m^2)

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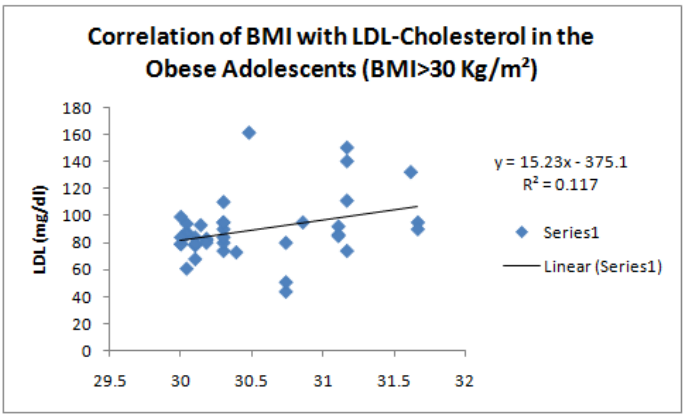

Fig V: Showing correlation of BMI with LDL Cholesterol in the obese Adolescents (BMI>30 Kg/m^2)

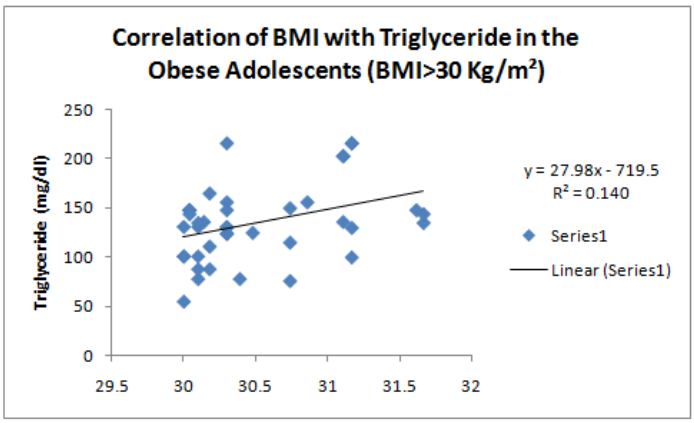

Fig VI: Showing correlation of BMI with Triglyceride in the obese Adolescents (BMI>30 Kg/m^2)

Comparison of means of FPG in the studied Groups

Group I and Group II NS, p>0.05;

Group I and Group III S, *p<0.05;

Group II and Group III NS, p>0.05.

Comparison of means of TSH in the studied Groups

Group I and Group II S, *p<0.05;

Group I and Group III S, **p<0.001;

Group II and Group III NS, p>0.05.

Comparison of means of Uric acid in the studied Groups

Group I and Group II NS, p>0.05;

Group I and Group III S, *p<0.05;

Group II and Group III NS, p>0.05.

Comparison of means of T. Cholesterol in the studied Groups

Group I and Group II NS, p>0.05;

Group I and Group III S, **p<0.001;

Group II and Group III S, **p<0.001.

Comparison of means of HDL in the studied Groups

Group I and Group II NS, p>0.05;

Group I and Group III S, *p<0.05;

Group II and Group III NS, p>0.05.

Comparison of means of LDL in the studied Groups

Group I and Group II NS, p>0.05;

Group I and Group III S, **p<0.001;

Group II and Group III S, **p<0.001.

Comparison of means of VLDL in the studied Groups

Group I and Group II NS, p>0.05;

Group I and Group III S, *p<0.05;

Group II and Group III NS, p>0.05.

Comparison of means of TGL in the studied Groups

Group I and Group II NS, p>0.05;

Group I and Group III S, *p<0.05;

Group II and Group III NS, p>0.05.

Discussion:

The world wide prevalence of childhood overweight and obesity increased from 4.2% in 1990 to 6.7% in 2010.This trend is likely to continue. The Prevalence in Asia is 4.9% in 2010.Dyslipidemia in children and adolescents is defined as total cholesterol level, LDL-c and or triglycerides (TG) higher than 95 percentile or HDL-c lower than 5 percentile for the age and

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sex[12].Overweight in children or adolescents is defined as body mass index (BMI) and the values more than 95 percentile for age and sex are defined obese[12]. BMI is notable to identify fat from muscle mass and also fat accumulation[13]. In our study BMI was regarded as cost effective and account indices to assess body fat distribution, body fat mass and obesity. Increase in visceral fat is associated with increase in secretion of free fatty acids, hyperinsulinemia, insulin resistance, hypertension and dyslipidemia[14, 15]. Several studies have demonstrated a class relationship between metabolic syndrome and hyperuricemia in adolescents. The prevalence of obesity has increased along with the increasing in the incidence of metabolic syndrome[16]. Some studies have shown that the morbidity of hyperuricemia plays an important role in cardiovascular disease, hypertension, DM type II[7].

Since TSH levels correlate with BMI and markers of insulin resistance, serum TSH concentrations>3.5µU/l also common in obesity[17]. A large epidemiologic study documented a positive relationship between serum TSH and dyslipidemia, suggesting subclinical hypothyroidism as an intermediate state between euthyroidism and overt hypothyroidism in terms of lipid profile[18].

In the present study the mean fasting plasma glucose level analysis shows significant difference between group I and III ($p<0.05$), however no significant difference was found between group I and II& group II and III. Again there was a significant difference of mean uric acid levels between group I and III ($P<0.05$).On the other hand the Pearson's correlation coefficient of triglycerides was found positively correlated with BMI>30.It was speculated that higher uric acid concentrations were associated with higher values of body adiposity markers weight and BMI. On the other hand individuals with high BMI may show insulin resistance, triglyceride alteration and high BP. And all these factors related to Uric acid increase[19].Uric acid increase is observed in individuals with insulin resistance, probably because hyperinsulinaemia would cause lower renal Uric acid excretion[19].Besides insulin could also indirectly affect Uric acid, since there is an association between hyperinsulinaemia and hypertriglyceridemia. Studies conducted by Valtuena S *et al* reported that serum uric acid level depends on insulin resistance and independent of age, sex, excess body weight, fat distribution and blood pressure[20].Ultimately obesity and DM may also be connected owing to increased oxidative stress as a result of its association with hyperleptinemia.[19].

Many evidences suggest that increased serum uric acid concentrations may be a significant risk factors of vascular disease. Ioachimescu *et al* believes that uric acid may casually/mechanistically contribute to vascular disease[21].

In our current study the mean cholesterol, triglyceride and LDL cholesterol levels were higher in group III ($P<0.05$) compared to group I& II. Our findings were consistent with the study done by Rema *et al*[22a].There was significant increase in mean serum uric acid level in group III compared to group I and II, similar results were observed by Butturini U *et al*[22b].

According to the study of Sarni *et al*, there was a significant correlation between HDL cholesterol and anthropometric indices in children and adolescents [23].The findings of our present study corroborate with the findings of Sarni *et al*.

Previous studies showed the prevalence of elevated TSH was seen in (1-21%) of obese children and adolescents and data of our present study is comparable to these studies[24, 25]. Again many studies

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have demonstrated elevation in serum TSH value in obese children when compared with normal weight children[26],[24],[25].Similarly in the present study, TSH values were elevated and showed significant difference between obese and normal children($p<0.001$) that is between group I & group III.

Conclusion:

Present study reveals that central obesity is an important risk factor for development of type II diabetes mellitus along with hyperlipidaemia and hyperuricemia in an early life. Moreover central obesity is an important risk factor for cardiovascular disease. Preventive interventions from childhood are necessary due to the increasing prevalence of childhood obesity. Our study was aimed to assess the association between anthropometric indices and dyslipidemia in obese children and adolescents. We have shown that there was positive correlation of fasting plasma glucose, TSH, uric acid, total cholesterol ,LDL cholesterol and triglyceride with anthropometric and biochemical indices. Dyslipidemia appears to be associated with the development of type II diabetes mellitus. Weight gain is Preventable and may be managed by life style intervention. Some school health Program by health experts and Physicians along with number of educational sessions and training programs about proper nutrition and importance of physical activity can play a very important role in improving lipid disorders of overweight children and adolescents. These programs are necessary to make changes in behavior and attitude of children and their families towards obesity.

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