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High prevalence of metabolic syndrome among competitive exam appearing students – An observational study from Guntur city, Andhra Pradesh

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Abstract: *Introduction: Metabolic syndrome is a pool of risk factors which are indicators of future development of cardiovascular disease and type 2 diabetes mellitus in adults. Stress is strongly associated with metabolic syndrome. Adolescents are more prone to academic stress and thus to metabolic syndrome also. Aim& Objectives: To determine prevalence of metabolic syndrome among the adolescent students appearing for competitive exams. Methods: A comparative descriptive study was conducted among the intermediate students of 16-19 years age group. Students were selected randomly from students residing at hostel in Sri Chaitanya junior college, Guntur. A sample of hundred students were selected, fifty from exam appearing students and another fifty from non-exam appearing students in the present academic year. Comparison done between both the students groups. Prevalence of metabolic syndrome was measured in both groups based on International Diabetes Federation Criteria. Relevant statistical tests were used to test the statistical significance. Results: Exam appearing students had higher values of waist circumference, blood pressure, fasting plasma glucose and triglycerides and lower values of HDL-Cholesterol. The prevalence of metabolic Syndrome was high among exam appearing students (34%) when compared to non-appearing students (6%). (X^2=12.25, P=0.0005) The risk of metabolic syndrome in competitive exam appearing students was eight times higher than in non-exam appearing students (OR=8.07). Conclusion: The prevalence of metabolic syndrome was significantly higher among the students appearing for competitive exams when compared to the students not appearing for competitive exams.*

Keywords: *Academic stress, competitive exams, IDF criteria, metabolic syndrome, prevalence*

I. Introduction

Metabolic syndrome can be considered as a pool of risk factors like disturbed glucose metabolism, abdominal fat distribution, overweight, mild dyslipidemia and hypertension in an individual. It is an indicator for the future development of cardiovascular disease and type 2 diabetes mellitus in adults [(1, 2)]. All these risk factors of metabolic syndrome may appear due to the presence of stress in an individual. Stress initiates several patho-physiological mechanisms to produce cytokines and reactive oxygen species, which in turn causes abdominal obesity, insulin resistance, and the other features of the metabolic syndrome [(3, 4)].

Different criteria were proposed to define and diagnose metabolic syndrome. Among all of them, International Diabetes Federation criteria is the most accepted one. It defined metabolic syndrome as the presence of central obesity along with any two of the following five conditions [(5)]:

1) Raised triglycerides: ≥ 150 mg/dL, or on specific treatment for this lipid abnormality
2) Reduced HDL cholesterol: < 40 mg/dL in males, < 50 mg/dL in females, or specific treatment for this lipid abnormality
3) Raised blood pressure (BP): systolic BP ≥ 130 or diastolic BP ≥85 mm Hg, or on treatment of previously diagnosed hypertension
4) Raised fasting plasma glucose (FPG): >100 mg/dL, or previously diagnosed T2DM
5) If BMI is >30 kg/m², central obesity can be assumed and waist circumference does not need to be measured.

Nowadays the society is transforming into a competitive world. Education is not an exception to this transformation. In spite of getting knowledge, securing marks and holding the top ranks became the goal of education. Both parents and teachers were expecting more and more from the students. These expectations putting the student under constant stress. Although competitive spirit is a positive stimulus for achievement of goals, severe and prolonged stress adversely effects the student's health. Along with this academic stress, some

students are also suffering with poor financial and family support. In spite of these, adolescent age itself is a risk factor of stress because of different physiological and psychological changes in the body and mind. Thus the students in the adolescent age group are more vulnerable to the stress[6] and metabolic syndrome also.

Every year in Andhra pradesh, about 3-4 lakhs of adolescent age group students are appearing for competitive exams like common entrance test for engineering and medicine (EAMCET). Seventy to eighty percent are taking coaching at various institutes. Based on this back ground the present study was conducted with an aim to estimate the prevalence of metabolic syndrome in the students of age group between 16 to 19 years in Guntur city.

II. Methodology

The current study was a comparative descriptive study conducted among the 16-19 years age group intermediate students residing at hostel in coaching institutes. A sample of hundred students were selected randomly by simple random technique from the intermediate studying students of Sri Chaitanya junior college, Guntur. Among the hundred selected students, fifty students from competitive exam appearing students and another fifty from non-exam appearing students in the present academic year. Twenty five male and twenty five female students were included in both groups. Students who gave informed consent were included in the study. Students suffering from acute illness were excluded from study. A Prior permission was taken from college administration to conduct the study and data was collected during the period December 2013 to January 2014.

International Diabetes Federation Criteria was used to estimate the prevalence of metabolic syndrome. Waist Circumference of students was measured by using a non-stretchable tape. Waist circumference ≥ 90 cm was considered as central obesity in males and ≥80 cm in females. Blood Pressure both Systolic & Diastolic blood pressures were measured using electronic BP apparatus.

Blood samples were collected by venepuncture in early morning, i.e., in 10-12 hours of fasting state from both groups to estimate Plasma Glucose, Total Triglycerides and HDL Cholesterol levels. Two samples were collected separately, one for glucose estimation and another one for triglycerides and HDL-cholesterol estimation. General precautions were taken at the time of sample collection, transportation to the lab, conducting the test, for ensuring the quality in results.

ESTIMATION OF GLUCOSE: Blood collected in a clean dry container containing sodium fluoride and EDTA. Sample was allowed to settle and then centrifuged for 5min at 500 rpm. Supernatant plasma was used for estimation. TRINDER'S METHOD, END POINT technique was used to estimate plasma glucose levels. Plasma glucose values in the range between 70 – 110 mg/dl were considered as normal values.

FOR ESTIMATION OF TRIGLYCERIDES AND HDL-CHOLESTEROL: Blood collected in a clean dry container, allowed to stand and then centrifuged. Clear serum without haemolysis was separated into clean tubes and labelled. GPO- TRINDER'S METHOD, END POINT and BY PHOSPHO TUNGSTIC ACID METHOD, END POINT were used to estimate triglycerides and HDL-Cholesterol levels. Triglycerides values in the range between 50 -150 mg/dl and HDL-C values in the range between 40-60 mg/dl were considered as normal values.

Comparison done between the students appearing for EAMCET exam at the end of the present academic year and students not appearing for EAMCET exam at the end of present academic year for the prevalence of metabolic syndrome. Gender wise comparison also done for assessing the influence of gender on metabolic syndrome. Standard error of difference between two means and chi-square tests were used for assessing the strength of statistical significance of results.

III. Results

The study population had average waist circumference of 84.77±10.64 cm, 115.26±9.64 mm of Hg & 74.62±5.34 mm of Hg systolic and diastolic blood pressures. The average fasting plasma glucose levels in the study population was 75.22±4.85 mg/dl. Mean triglyceride and HDL-Cholesterol levels in the study population were 111.31±30.00 mg/dl and 44.6±8.43 mg/dl respectively.

The mean waist circumference in exam appearing students was 81.76 cm ± 10.16 cm, where as in non-exam appearing students the average waist circumference was 87.78 cm ± 10.23 cm. The mean systolic and diastolic blood pressures in exam appearing students was 119.56 mm of Hg ± 8.87 mm of Hg, 76.68 mm of Hg ± 5.12 mm of Hg, where as in non-exam appearing students average blood pressures were 110.96 mm of Hg ± 8.65 mm of Hg, 72.56 mm of Hg ± 4.76 mm of Hg. The mean fasting plasma glucose levels in exam appearing students was 76.10 mg/dl ± 4.72 mg/dl and in non-exam appearing students was 74.34 mg/dl ± 4.81 mg/dl. The mean total triglycerides in exam appearing students was 123.56 mg/dl ± 32.26 mg/dl, where as in non-exam appearing students total triglycerides was 99.06 mg/dl ± 21.39 mg/dl. The mean HDL-cholesterol levels in exam appearing students was 41.54 mg/dl ± 8.74 mg/dl, where as in non-exam appearing students mean HDL-cholesterol was 47.66 mg/dl ± 6.84 mg/dl.

Standard error of difference between two means of exam appearing students and non-exam appearing students were calculated and found that, the difference was statistically significant between the mean values of all the risk factors viz., waist circumference, systolic and diastolic blood pressures, total triglycerides and HDL-Cholesterol levels except in fasting plasma glucose levels.

Table no.2 shows that, female students had more waist circumference than male students and the difference was statistically significant. The difference between male students and female students in other metabolic syndrome risk factors was not statistically significant. The mean HDL-cholesterol levels in female students was 45.7 mg/dl. This value was less than 50 mg/dl which is a cut-off point for metabolic syndrome in female students according to International diabetes federation criteria.

The figure no.1 explained that among the six risk factors only four risk factors present in the both groups. Fasting plasma glucose levels and Diastolic blood pressure were normal in both groups. Prevalence of low HDL-cholesterol levels was high followed by abdominal obesity in both groups. Competitive exam appearing students had more risk of metabolic syndrome when compared to non-exam appearing students.

The figure no.2 showed that, prevalence of low HDL-cholesterol values and abdominal obesity was high among males and females. Females had more number of risk factors of metabolic syndrome when compared to males.

According to International Diabetes Federation Criteria, the total prevalence of metabolic syndrome in exam appearing students was 34% and whereas in non-exam appearing students the prevalence was only 6%. It indicated high prevalence of metabolic syndrome in exam appearing students when compared to control groups. The difference observed was statistically significant (X^2=12.25, df=1 P value=0.0005). More number of males had high metabolic syndrome, when compared to female students. But the difference observed was not statistically significant (X^2=1, df=1 P value=0.3173). The risk of occurrence of metabolic syndrome is eight times higher in competitive exam going students when compared to non-exam appearing students (Odds Ratio=8.07). The risk of metabolic syndrome was 1.6 times more in males when compared to females. (OR=1.65)

IV. Discussion

In our present study exam appearing students have higher values of all the variables of the metabolic syndrome than their control groups except HDL-Cholesterol values, when compared to control groups. The difference between both groups exam appearing students and non-exam appearing students for all these variables were statistically significant and proved the relation of metabolic syndrome and chronic stress, except in the fasting plasma glucose values .The difference between both groups for fasting plasma glucose levels was not significant.

Normal Fasting plasma glucose levels were observed in the current study. This may be due to the reason, glucose intolerance may develop later than other remaining syndrome abnormalities. It can be explained by three-stage model for the development of T2DM proposed by Beck-Nielsen and Groop [(7)]. Stage 1 includes fasting hyperinsulinemia with normal or slightly increased blood glucose, Stage 2 is characterized by prediabetic glucose intolerance with insulin resistance and Stage 3 is development of T2DM. But, many of the macro vascular changes associated with T2DM and related to CVD begin in stages 1 and 2, well before diagnosis. Hence the appearance of normal glucose levels is not an indicator of no risk for CVDs. The individual may fall in the first stage of Type 2 Diabetes mellitus.

The total prevalence of metabolic syndrome in test groups is 34% and in control groups is only 6%, indicating high prevalence in students preparing and appearing for competitive exams than in non-exam appearing group of students. It showed the impact of academic stress on students. It indicated that, mainly coaching and preparation for competitive exams creating a chronic stress on the adolescent students and greatly enhancing the risk of metabolic syndrome even at a younger age.

Coming to the gender, females had more number of risk factors of metabolic syndrome when compared to males. But the concurrence of at least three risk factors in a student was more in males.

Narinder Singh et al., [(8)] in his study among school going adolescents aged 10-18 years reported that, metabolic syndrome was most prevalent in 16-18 years age group (4.79%) and higher in males (3.84%) than in females (1.6%). They also reported that 33% of obese adolescents are at risk to develop metabolic syndrome.

Tarani Chandola et al., in their study[(9)] reported a dose-response relation between exposure to work stress and risk of the metabolic syndrome. They also stated that, employees with chronic work stress were more than two times at risk to have the syndrome, than the employees without work stress.

From these studies it is suggested that chronic stress could increase the prevalence of metabolic syndrome. The same was observed in the current study.

V. Tables and Figures

Table no.1 Mean values of metabolic syndrome risk factors in exam appearing students and non-exam appearing students

Variable	Total students n=100	Exam appearing students n=50	Non-exam appearing students n=50	Z value (P value)
Waist circumference in cm	84.77±10.64	81.76 ± 10.16	87.78 ± 10.23	2.96 (<0.05)
Systolic blood pressure in mm of HG	115.26±9.64	119.56 ± 8.87	110.96 ± 8.65	4.94 (<0.05)
Diastolic blood pressure in mm of HG	74.62±5.34	76.68 ± 5.12	72.56 ± 4.76	4.20 (<0.05)
Fasting plasma glucose in mg/dl	75.22±4.85	76.10 ± 4.72	74.34 ± 4.81	1.83 (>0.05)
Total triglycerides in mg/dl	111.31±30.00	123.56 ± 32.26	99.06 ± 21.39	4.47 (<0.05)
HDL-C in mg/dl	44.6±8.43	41.54 ± 8.74	47.66 ± 6.84	3.92 (<0.05)

Table no.2 Mean values of metabolic syndrome risk factors in male and female students

Variable	Total students n=100	Male students n=50	Female students n=50	Z value (P value)
Waist circumference in cm	84.77±10.64	80.86±10.40	88.68±9.33	3.95 (<0.05)
Systolic blood pressure in mm of HG	115.26±9.64	117.08±9.46	113.44±9.73	1.89 (>0.05)
Diastolic blood pressure in mm of HG	74.62±5.34	74.44±5.28	74.8±5.43	0.33 (>0.05)
Fasting plasma glucose in mg/dl	75.22±4.85	76.08±5.35	74.36±4.11	1.80 (>0.05)
Total triglycerides in mg/dl	111.31±30.00	113.18±34.87	109.44±24.12	0.62 (>0.05)
HDL-C in mg/dl	44.6±8.43	43.5±8.23	45.7±8.49	1.31 (>0.05)

Table no.3 Prevalence of Metabolic syndrome

Risk factor	Metabolic syndrome	Metabolic Syndrome present (%)	Metabolic syndrome absent (%)	Total n=100 (%)	P value
Academic stress	Present n=50	17 (34%)	33 (66%)	50 (100%)	X^2= 12.25, P = 0.0005, OR = 8.07
	Absent n=50	03 (6%)	47 (94%)	50 (100%)	
	Total	20 (20%)	80 (80%)	100 (100%)	
Gender	Male n=50	12 (24%)	38 (76%)	50 (100%)	X^2 = 1 P = 0.3173 OR = 1.65
	Female n=50	8 (16%)	42 (84%)	80 (100%)	
	Total	20 (20%)	80 (80%)	100 (100%)	

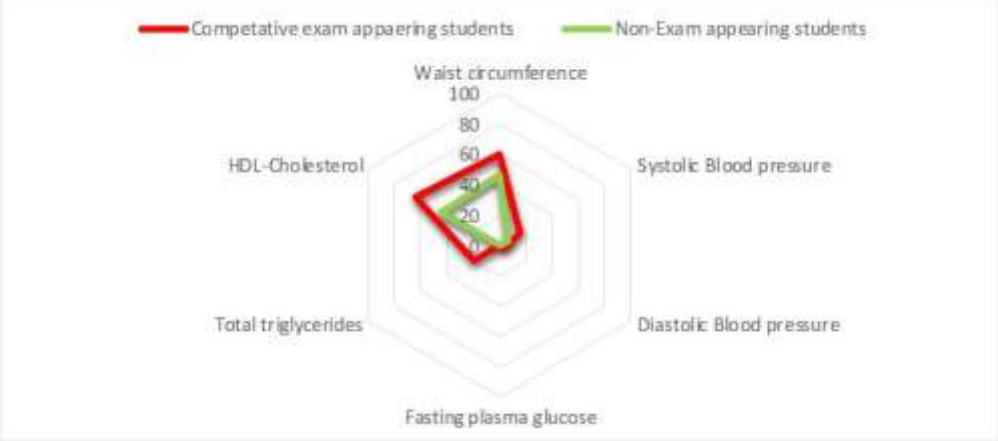

Figure No. 1. Prevalence of risk factors of metabolic syndrome in percentage

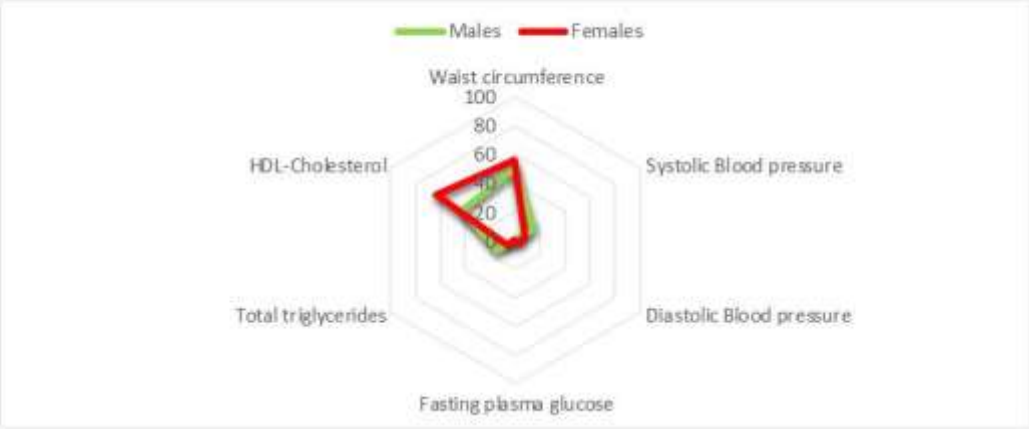

Figure no.2 Gender wise prevalence of risk factors of metabolic syndrome in percentage

VI. Conclusion

The prevalence of metabolic syndrome was significantly higher among the competitive exams appearing students than among the non-exam appearing students. It was indicating a risk of future development of cardio vascular diseases and Type 2 Diabetes mellitus in adolescent students. Academic stress due to competitive exam was strongly associated with metabolic syndrome. Stress free environment in the academic institutions and family support were needed to reduce the stress upon students and in turn to reduce the prevalence of metabolic syndrome.

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